DISEASES

OF

THE EAR IN CHILDREN

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CONTENTS.

DISEASES OF THE EAR

IN CHILDREN.

I. THE DISEASES of the EXTERNAL EAR,

VIZ., OF THE

AURICLE, MEATUS, AND DRUM-MEMBRANE.

Congenital Variations and Malformations.

Literature. The older literature is given abundantly in Linke's Handbuch der Ohrenheilkunde (Leipzig, 1837), Vol. I., p. 582 et folg.; also in Vol. II. (1845), p. 440 et folg.; also in Huschke's edition of Sömmering's Anatomie, Vol. V. (Leipzig, 1844), p. 901.—Wilde's Aural Surgery, German Translation (Göttingen, 1855), p. 191.—Rau, Lehrbuch der Ohrenheilkunde (Berlin, 1856), pp. 329–334.—Förster, Missbildungen des Menschen. Jena, 1861, pp. 46 and 170.—Welcker, Archiv für Ohrenheilkunde, I., p. 136.—Kollman, Zeitschrift für Biologie, IV., p. 260.—Virchow, Archiv für pathologische Anatomie, XXX., p. 221, and XXXII., p. 518.—Gruber, Lehrbuch der Ohrenheilkunde. Wien, 1870, p. 273.—Schmitz, Ueber Fistula Auris congenita und andere Missbildungen des Ohres. Diss. inaug., Halle, 1873.—Very complete descriptions of malformations, with illustrations, are contained in Schwartze's Pathologische Anatomie des Ohres, which constitutes the sixth part of Kleb's Handbuch der pathol. Anatomie. Berlin, 1878, pp. 22–28 and 31. Translation by Green "The Pathological Anatomy of the Ear." Boston, 1878.

On the Foramen Rivini, see Huschke, l. c., p. 822.—Hyrtl, Vergleichend-Anatomische Untersuchungen über das innere Gehörorgan. Prag, 1845, p. 53. Also the author's Lehrbuch der Ohrenheilkunde. Sechste Auflage, Leipzig, 1877, p. 31.—Schwartze, l. c., p. 46.

It is well known that the auricle varies very much in its angle of insertion to the skull, in its size and form, and also in the development of its different prominences and depressions. Certain marked variations, as, for instance, abnormal flatness of the cartilage with an absence of its inner border and of the antihelix, or an unusual standing out from the head, with or without an increased development in the convexity of the concha, a pointed instead of the usual rounded helix, constituting the pointed or faun's ear, are frequently found in different members of the same family, so that there can be no doubt about the hereditary character of these peculiarities in form, and their presence in father and child might be, in some cases, a more valuable proof of legitimacy than the genealogical tree.[1]

It has been asserted that sometimes, also, there is a congenital complete absence of the auricle. In most of the cases which have been so called, a more accurate investigation would probably develop remnants of the aural cartilage, although, perhaps, only slight ones. Stunted and rudimentary formation of the auricle is by no means a great rarity; with it there is always an abnormal condition of the meatus, and very often also such an important malformation of the deeper parts of the ear that the hearing is very seriously impaired or wholly destroyed. Unilateral deformity of the auricle is often found with unilateral atrophy of the face.[2]

Portions of cartilage of a greater or less size, and generally lobular in shape and covered with a skin, which, in some cases, is pigmented, are not infrequently observed in front of or beneath the auricle. They are to be regarded as indications of excessive or double development;

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[1] Amédé Joux (Gazette des Hôp., Fevr., 1854) "Montre-moi ton oreille, je te dirai, que tu es, d'où tu viens et où tu vas."

[2] Two such cases are figured by Schwartze, p. 24.

some cases have been described where the second auricle was present in a well-developed form.

Congenital abnormities of the meatus are found more commonly with than without deformity of the auricle; they consist of different degrees of contraction, closure, or of absence of the meatus. They do not always begin at the entrance of the ear-passage, for this may, in some cases, be relatively normal, while deeper in the canal narrows or ends blindly, being closed in some cases by a membrane, in some by bone. Double meatus, in the form of a very narrow canal lined with skin, before or above the tragus, and usually associated with a lobule of skin and cartilage, I have seen several times. Heusinger first described such a case as fistula auris congenita, the remains of the first branchial fissure. This aural fistula is found with or without malformation of the auricle, and is sometimes associated with fistula in the neck.

If we have to deal merely with a diminution in the calibre of the external and dilatable portions of the passage, much can be accomplished by dilatation, especially by means of laminaria digitata. If, however, no open meatus exists, every operative procedure should be postponed till it has been decided in what degree the hearing on the affected side exists or is wanting. The latter is very frequently the case, owing to the existence of arrests of development and other defects in the middle and internal ears. But, even if the existence of good hearing has been established, it should be borne in mind, not only that there is great difficulty in keeping open an artificially made canal, but, also, that it is necessary to use the greatest care in the operation, in order that the new passage may reach the drum-membrane.

If the osseous meatus is entirely absent, every operation is useless; it may, however, be present together with a drum-membrane, and yet not be easy to find. Rudimentary auricles are not always situated in the nor-

mal position, so that we cannot be certain by incision close in front of the cartilage of reaching the meatus and drum-membrane even when they are present; both may lie in a different direction from usual from the auricle.

Congenital malformation of the drum-membrane is seen during early life in the form of an appreciable opening in the upper portion of the membrane without there having been previous suppuration. As the drum-membrane is entirely absent in the earliest embryonic life, and as it closes at last in its upper part, an insufficient closure, i. e., an opening, may exist at this spot as an arrest of development, which may be considered as a coloboma analogous to similar conditions in the eye, the lips, and the palate.

It has occurred to me that some of the perforations of the drum-membrane just above, before, or behind the processus brevis mallei, such as are seen with otorrhœa, were originally congenital and possibly enlarged by a subsequent suppuration within the tympanum. Certain it is that in a tympanum so exposed externally an inflammation would occur more readily than in one which was protected and closed normally, and it is also evident that, if an abundant secretion is formed behind the drum-membrane, it would be discharged earliest through an opening already in existence on the most yielding spot—the edges of the opening would thus readily become irritated—and if the process continued for a long time, the existing opening would be enlarged.

It is well known that anatomists, particularly the earlier ones, disputed much over the question whether the drum-membrane in its normal condition had any opening. It is very probable that the frequent discovery of these congenital arrests of development, which are probably not very rare, led to the assumption of the existence of a constant foramen Rivini. Such a foramen certainly does not exist.

In those cases in which an early examination of a child has confirmed the existence of such a congenital opening in the drum membrane, care should be used against the injuries which may occur. In order that small masses of cerumen may not fall into the tympanum, regular cleansing of the meatus by gentle syringing or by a small sponge is indicated: the ear should also be protected in bathing, in the use of cold applications about the head, and especially it should be guarded against injuries from the weather.

The whole external ear as well as the tympanum and Eustachian tube are developed from the first and second branchial fissures, which is the reason why external and internal malformations so often exist together. As both the jaw and the palate are also developed from the first branchial fissure, it is not surprising that congenital malformations of the ear, of the lips, and of the palate should be often found in the same individual. In this connection, I would also say that malformation of the palate, in the form of fissured uvula of different degrees, is very much more common than malformation of the ear.

The Diseases of the Auricle and Meatus.

Passing now to the peculiar diseases of the auricle, it will be understood that the skin covering it may be involved in affections of the skin in its neighborhood, of which it is unnecessary to go into particulars here. The most interesting fact is that an eczema, either in its acute or in its chronic form, is often localized on this organ. If of long continuance or frequent recurrence, it may produce permanent disfigurement and discoloration; obstinate dermatitis at the angle of insertion of the auricle may also diminish this angle, and cause the auricle to lie more closely against the skull; the firm binding of the ears in a cap may also produce the same result. Bits of charpie dipped in olive oil or lead water will prevent such

a deformity. During the acute stage of an eczema, all irritation of the œdematous and swollen skin by fatty substances or by keeping the parts warm should be avoided: occasional luke-warm fomentations of very weak astringents and frequent sprinkling of the part with toilet powder tend to diminish the annoying burning and the tense swelling of the cartilage. In chronic eczema, care should be taken to protect the auricle with a leather cap, adapted to the size and form of the part, in order that the salves and fat which are applied to soften the crusts may be kept on for a long time. The hair should be cut from the neighborhood and the cartilage frequently powdered; if these precautions are not taken, the bedding and hair stick to the moist spots, and their removal irritates the surface, producing excoriations and bleeding. By means of such a cap as has been described, the meal or powder toilet will most effectually alleviate the itching and prevent scratching with the hands.

For the examination of the meatus and the drum-membrane, good illumination is of the first importance. The most convenient way of getting this is by means of a concave mirror seven to nine ctm. in diameter and of fifteen to twenty-four ctm. focus, by which diffuse daylight can be reflected into the ear. If the sky is very bright, or direct sunlight is to be used, or if it is necessary, on account of the time of the day or the darkness of the room, to use a lamp or candle, a plane mirror, such as a simple toilet hand-glass, should be used for reflecting the rays of light into the ear and into the meatus. If, with the fingers of one hand, the auricle is drawn backwards and the tragus forwards, the external portion of the canal and often also the internal portion with the drum-membrane, can be clearly seen. More commonly, however, the narrowness of the meatus and the presence of numerous hairs on its walls make it necessary to introduce a speculum in order that we may be able to illuminate the deeper parts.

The most useful forms of specula, in my opinion, are the funnel-shaped tubes made of thin silver, and in most cases in children, those of four to five mm., and rarely of six mm. diameter, can be used. Specula of hard rubber are cheaper, but less enduring, and also require more light. While the speculum is being inserted, the auricle should be drawn upwards and backwards with the other hand, as by this means the meatus is rendered more straight. When the instrument has been carried in far enough, the mirror should be taken up, but without letting go of the speculum; for if this is done, the cartilaginous meatus falls back into place, and the instrument may drop out. As long as the examination lasts, the speculum should be pressed lightly on the upper wall of the meatus with one hand, so that the cartilaginous passage is held upwards and backwards. By great practice it may become possible to hold both speculum and mirror with one hand, leaving the other hand free for operations, etc.; but a better way in cases in which it is desirable to have one or both hands free, is to use a mirror attached either to a strong spectacle frame or to a forehead band. If two small holes are made in the edges of the speculum, an elastic cord may be passed through them and around the head of the patient in such a way as to fix the speculum in the ear, and with a little ingenuity an elastic band may be attached to the handle of a common reflector, so that this can be bound to the head of the observer.

As the meatus of children is narrow and usually secretes freely, it is often necessary, before an examination, to cleanse the passage in order to get a clear view of the deeper parts. This can be accomplished either by syringing with warm water or by wiping it out with a camel's-hair brush, or with cotton wool rolled around an indented rod. After syringing it is best to dry out the passage.

Obstruction of the meatus with cerumen is by no means rare in children. The obstructing mass is

more commonly semi-solid, yellowish, and mixed with abundant epidermal scales from the skin of the meatus than hard and dark-colored. Especially after inflammations of the meatus or diseases of the skin which are associated with desquamation, like scarlet-fever, the amount of secretion from the skin of the meatus is often very much increased, so that the passage is wholly or partially closed and the hearing diminished. Syringing with warm water for a few times is usually sufficient to relieve this condition.

It should be understood that every child, in the latter part of intrauterine and the first part of extrauterine life, possesses no free meatus, the passage being closed by epidermal products. This physiological condition of the meatus in a new-born child will be understood when it is remembered that at this period of life the drum-membrane, instead of being perpendicular, is very flat and nearly horizontal, so that it forms with the lower wall of the meatus, which is at this age membranous, but later becomes osseous, a very acute angle, and lies nearly on the same plane as the upper wall of the ear-passage. The drum-membrane, which is covered at this age with a very thick epidermis, thus lies directly opposite the lower wall of the meatus, and these two surfaces must almost touch each other at all points. If it is also remembered that the amniotic fluid, in which the fœtus lives, moistens the surfaces within the meatus, and that the vernix caseosa covering the whole surface of the new-born child must collect in considerable quantities in the narrow canal, it will be seen how impossible it is for any air cavity to exist in the medial portion of the meatus until these superficial deposits have been cleared out or by drying have fallen out, and until the moistened epidermis of the drum-membrane has become shrivelled up and been cast off. The most important element, however, in the production of an air cavity in front of the drum-membrane is the perpendicular

position which the membrane rapidly assumes after birth, thus separating it from the lower wall of the meatus; the process is also assisted by the enlargement of the passage resulting from the development of the skull.

From this condition of the meatus, it is evident that man, just after birth, has no better hearing than other animals of the same age which are born with an impervious meatus. A few accurate observers[1] have called attention to this deafness of new-born children, although the subject is worthy of still closer experimental investigation in regard to its degree and duration. Instillations of warm water into the ears of new-born children will clear the passages earlier than they would clear themselves, and the same procedure is advisable occasionally for some time, as, if the masses of epidermis remain in the meatus, they become gradually hard, and are liable to be a source of irritation to the drum-membrane and the walls of the narrow canal.

We come now to the inflammations of the meatus, of which the first to be noticed is the follicular inflammation or furuncle. This does not seem to be very common in children, and in its form and course at this age offers no special peculiarities. Originating either in a hair-bulb or in a sebaceous gland, both of which structures lie in the deeper layers of the skin and are only found in the lateral portion of the canal, this circumscribed inflammation is characterized by a localized swelling in the cartilaginous meatus, producing a tumor which projects into the passage and diminishes its calibre. The painfulness of these inflammatory tumors is very variable, depending upon the yielding character of the spot where they lie; it is always greatest on touching the ear or on movement of the lower jaw. The tension and swelling often extend to the tissues in the neighborhood of the ear; and the auricular lymph-

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[1] O. Kussmaul, Untersuchungen über das Seelenleben der neugeborenen Menschen. Leipz. u. Heidelberg, 1859, p. 27.

glands over the mastoid, beneath the auricle just behind the angle of the jaw, and in the tissue of the parotid, are liable to be involved, especially in children. Marked febrile disturbance, therefore, not infrequently accompanies this affection which in itself is slight. Serous infiltration of the surface of the meatus comes on rapidly, but a discharge of pus does not occur till between the third and sixth day, when the abscess, which in the mean time has been increasing, bursts, and its scanty contents are evacuated into the meatus. With this crisis all symptoms are diminished or cease entirely, and this result can be hastened, as in the case of furuncles generally, by the application of moist warmth. For this purpose the meatus, if not too much swollen, should be filled frequently with warm water or with warm olive-oil, and such ear-baths should be continued for half an hour at a time. A roll of charpie dipped in olive-oil and filling the meatus is often of great service. If the furuncles are very painful, poultices may be applied to the meatus, but they should not be very hot and must be as small as possible; they should also not be used any longer than is absolutely necessary. It should be borne in mind how sensitive the skin of many children is, and before applying the poultices, the external ear should be protected by a covering, so that erythema or eczema may not be produced. Sometimes under this treatment and also sometimes without any treatment, no abscess forms, but the swelling is dispersed. If the symptoms from the inflammatory tension of the tissues are very annoying, it is best to open the abscess with a small bistoury after finding the seat of the furuncle, by feeling for the most sensitive spot by means of a Daviel's spoon. As soon as the abscess has opened in one way or another, it is necessary, for the thorough evacuation of its contents, and in order to get rid of the increased secretions from the skin of the meatus and of the blood from the incision, to syringe the ear with warm water, and this should be repeated after from eight

to fourteen days. Too frequent syringing should be avoided, however, as repeated moistening of the skin of the meatus may easily produce renewed swelling and another furuncle. Quite often several furuncles appear one after another. Local antisepsis, as for instance painting with carbolized oil, seems to be very valuable as a preventive of furunculosis. The skin of the meatus should also be carefully examined, as a slight squamous or impetiginous eczema is not infrequently the cause of recurring follicular abscesses. Such eczemas, from the itching which accompanies them, cause the patients to scratch or work upon the ear, and this mechanical irritation easily predisposes to fresh inflammations.

Furuncle of the meatus never leads to permanent injury of the ear or of the general health, except possibly in cases in which injudiciously warm or continuous poulticing produces an extensive softening and inflammation of the tissues; the otitis externa or diffuse inflammation of the meatus, however, requires a more thorough description on account of the possible results following it.

Under the name otitis externa are included for the sake of convenience all the various forms of inflammation which attack the lining membrane of the meatus and the external surface of the drum-membrane. The latter membrane is covered by a continuation of the skin of the meatus which is very thin and which contains the chief blood-vessels and nerves of the drum-membrane, so that the external surface of the membrana tympani, being composed of the same histological elements and subject to the same influences of nutrition and innervation as the meatus, must necessarily be involved in all pathological changes which affect this passage in toto.

The otitis externa is particularly an affection of childhood and many of the aural affections of adults which are accompanied by otorrhœa may be referred to diffuse in-

flammations of the meatus which occurred in early life. The causes of otitis externa are both numerous and various. The several diseases of the skin, both those which are diffuse and those which are localized on the face, may extend to the lining of the meatus; the acute exanthemata,[1] measles, scarlet-fever, and small-pox, also eczema and erysipelas are found in the meatus, sometimes in a pronounced, sometimes in a slight degree.

In adults it is not uncommon to see broad condylomata, the secretion from which, flowing into the meatus, may set up an intense inflammation;[2] it is very possible that, in children also, syphilis universalis, which with them is congenital, may be localized on the skin of the meatus or at the entrance of the passage and appear in the form of moist papules or of pemphigus vesicles. Direct injuries often produce inflammation of the meatus and of the surface of the drum-membrane. Among these are to be mentioned cold applied directly to the ear, generally in the form of ice-water which, applied to the head for any cause, runs into the ear; or a rapid change of temperature, such as carrying a child directly from the warm chamber into a cold church. Similar injuries result from the application of warmth, most commonly from too hot poultices or syringings, occasionally from actual scalds and burns, also from the application or instillation of irritating chemical substances such as alcohol and salt, eau de cologne, crushed garlic, etc.

Some forms of inflammation of the external ear, and these the most painful and obstinately recurring, are pro-

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[1] According to the observations of Wendt (Archiv für Heilkunde, xiii.), in patients with measles pustules are common in the external portions and rare in the deeper portions of the cartilaginous canal, but are never found in the osseous canal; while in patients with variola hyperæmia and swelling of the osseous canal, although not constant, are quite common.

[2] Aug. Stöhr, "Ueber Bildung von breiten Condylomen im äuss. Gehörgang." Archiv f. Ohrenheilkunde, v., 130.

duced by vegetable parasites which find in the meatus a favorable soil for development and increase, and by their rapid growth produce a constantly increasing inflammation. This parasitic form of otitis externa is particularly common in the deeper portions of the meatus and on the drum-membrane; it produces an increased formation of moist epidermal lamellæ which generally are superposed one upon another and may produce a closure of the canal, or may form a mould of the inner end of the meatus which resembles the finger of a glove; on and between the epidermal scales there is always a deposit of mould-fungus, sometimes of light, sometimes of dark color. These almost always belong to the aspergillus family.[1]

It is possible that animal parasites, taking up their abode in the human meatus, act as an irritant. This could be suspected in children who have much to do with birds or rabbits. It is known that bird-lice (dermanyssus avium), which are abundant in house-birds and also in hen-houses and dove-cots, are found on the human skin and under certain conditions beneath the skin, where they frequently produce slight inflammations; such parasites have been observed in the ear of an ox[2] where they were the probable cause of a severe otitis externa purulenta. In rabbits, the frequent companions of man, purulent inflammations of the external and middle ears are quite often caused by the borings of psorospermias and gregarinas; as the disease is known to be transmissible to other animals, it is possible that it is also transmissible to man.[3]

The worst forms of otitis externa are seen in the cases

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[1] Vide: Schwartze, Archiv f. Ohrenheilk. (1865), ii., p. 5; Wreden daselbst (1867), iii., p. 1, mit Taf. i., and in "Myringomykosis aspergillina." St. Petersburg, 1868; Steudener, Arch. f. Ohrenh. v., 163 und ix., 128, etc.

[2] Author, "Zur Lehre von den thierischen Parasiten am Menschen." Arch. f. Ohrenheilk. (1875), ix., 193 und x., 247.

[3] Zürn, "Die Ohrkrankheiten der Kaninchen." Deutsche Zeitschr. f. Thiermedizin u. vergl. Pathologie. Trautmann, Arch. f. Ohrenheilk., xi., 272.

of foreign bodies which, getting into the meatus accidentally, have been worked upon with more energy than skill: we shall speak later of these traumatic cases which are frequently associated with phlegmonous abscesses, necrosis, and even more serious results. According to some authors, the appearance of a tooth is, in certain children, attended by an inflammatory irritation of the meatus. It is certain that, not infrequently, an otitis externa is developed without our being able to find a distinct cause for it, and this occurs often in unhealthy or scrofulous children, but is also seen in healthy ones. It should also be said that sympathetic swelling of the lymph-glands in the neighborhood of the ear and on the side of the neck are often seen as the result of chronic aural inflammations and disappear of themselves after a purely local treatment of the ear. Care should be taken not to assume that these glandular swellings are necessarily "scrofulous" and that the "scrofulous" ear-disease should be treated chiefly by general medication. In these cases such a treatment will be of no avail and even in true scrofulosis the local treatment of the ear will always accomplish the most.

From the great multiplicity of causes producing otitis externa it is evident that the disease must run various courses, and that the appearances in the ear must vary very much according as they are produced by one or the other of these; the form with measles runs a different course and has a different appearance from that with small-pox, the traumatic or caloric is different from the parasitic, etc. To describe the peculiarities of each would appear superfluous to the thoughtful physician. Certain general characteristics of the inflammation of the meatus and of the surface of the drum-membrane are, however, common to all the forms, such as hyperæmic swelling and infiltration of the superficial tissues of the whole passage, together with a certain amount of pain and deafness. The redness and injection are most marked in the osseous meatus and

on the membrana tympani, as at these spots the vessels are covered with a less thick epidermis: at these spots also, large or small hemorrhages are sometimes seen. The swelling, on the other hand, is most pronounced in the external parts from a similar reason, is concentric and on the whole circumference of the passage, and not, as in furuncle, on one side or at one spot. The calibre of the meatus is usually less narrowed or closed than it is with furuncle, and the amount of deafness is chiefly dependent on the degree of intensity with which the membrana tympani is involved in the pathological process. The more this membrane is affected the more severe and long-continued will the pains be; but when the meatus is the seat of the inflammation, as a rule, the pains are less racking, boring, and pulsating than with furuncle. The more the cartilaginous meatus is inflamed the more the pains will be increased by pressure upon the ear and by movements of the lower jaw; on the other hand, the more the drum-membrane is affected the greater is the effect produced by every jar of the head, such as coughing, sneezing, or a blow, as in this way the inflamed membrane is moved and mechanically irritated. In sensitive children with severe inflammation, a febrile reaction is seldom absent at the height of an otitis externa; but it sometimes occurs that a sudden suppuration of the meatus shows itself in children without any local or general symptoms having been noticed previously; or at least the only thing noticed was that the child kept working at the ear with the finger. On the second or third day, generally earlier than with furuncle, the stage of congestion passes into that of exudation with a diminution of the swelling, an unloading of the blood-vessels, and improvement of the general condition; the secretion, at first serous, rapidly becomes creamy and purulent. In some cases, however, especially in those of the parasitic variety, instead of a fluid secretion moistening the pillow or dropping from the ear, there is an increased desquamation, or in the

eczematous cases a formation of crusts, both of which conditions can only be discovered by examination.

Some authors, as Rau,[1] speak of a mucous secretion with otitis externa, but there must be in such cases an error in diagnosis. Either the secretion is not mucous or the otitis is not external; the two are incompatible. The external meatus is not lined with a mucous membrane, as one so often hears and reads, but by a continuation of the external skin, which becomes thinner and thinner as it passes inward; consequently the skin of the meatus can no more produce mucus than the skin on other parts of the body, and, if mucus is really found in the meatus, from this alone we can conclude that the middle ear, which has a mucosa and consequently secretes mucus, is or has been opened by a hole in the drum-membrane. In children, it often happens that, after a short period of pain, lasting perhaps only a few hours of the night, mucus is found in the meatus: close examination will then show a reddish spot or streak in the drum-membrane, so slight as to be easily overlooked. At this spot a rupture has taken place which allowed the discharge of mucus from the tympanum, and the edges have fallen together and rapidly united. The child, which before this occurred was quite deaf, had pain in the ear or head with a sense of weight there, which had some fever and was more or less dull, or, as sometimes happens, was abnormally excited, will now hear better, the head is relieved, and the temperature is normal. This process was, however, not an otitis externa, but an otitis media which ran its course quickly with early perforation of the drum-membrane and consequent evacuation of the secretion, but it will probably recur with the next cold in the head. These varieties of disease are usually associated with the dentition, but to me it seems more plausible that the source of the disease should be sought usually in the

[1] Lehrbuch der Ohrenheilkunde. Berlin, 1856, p. 181.

naso-pharyngeal mucosa, which is in the immediate neighborhood of and in direct connection with the ear, and from which the inflammation extends to the ear directly along the Eustachian tube rather than in a much more indirect way by referring it to the dentition.

If a child with an acute otitis externa in the stage of exudation is to be examined, the ear must always be first cleansed by syringing, as the field of view, at the best very small, is very much contracted by pus covering the deeper parts, by scales of epidermis adhering to the walls of the passage, or by crusts formed by dried secretion. The syringing should be with a slow, interrupted stream, as the parts are unnaturally sensitive from the inflammation, and the drum-membrane is friable and easily torn. The epidermis in the whole passage is seen to be thickened, collected in irregular masses, and in spots raised from the corium, so that the latter appears red and granulating. The drum-membrane, normally glistening and concave, appears dull and flat; the boundary between it and the meatus is less sharply marked; the manubrium of the hammer, which normally appears as a whitish line, is either invisible on account of the great œdema and hypertrophy of the epidermal and connective-tissue layers covering it, or can barely be distinguished. Not infrequently shreds of epidermis hang from the drum-membrane or have already separated from it. No reference is made here to the local appearances in variola, syphilis, etc., which have been already spoken of and which are never destitute of their own peculiar characteristics. If the suppuration has been of long continuance, or the case is one in which the acute painful stage was wanting and the course has been, from the beginning, chronic, the pus is mixed with abundant, often bloody serum, rendering the discharge thin; a strong offensive odor is also rapidly developed in the ear. In these cases, with or without a narrowing of the canal, the exposed corium often develops

granulations or prominences in the form of a ridge or cockscomb which are generally concealed under discolored dark crusts.

Both in its course and in its results, the otitis externa is very variable. In its very light forms it may merely produce swelling without any exudation, or the suppuration may cease of itself without any treatment, and there is left only a certain amount of opacity and thickening of the drum-membrane which gadually disappears if the suppuration has not continued very long. In many cases, on the other hand, especially when the disease has not been properly treated, the suppuration becomes chronic and leads to very numerous sequelæ. Sometimes there is great thickening and flattening of the drum-membrane, frequently with depositions of lime in the membrane, and sometimes there is permanent diminution of hearing of various degrees. Sometimes true polypi are developed from the granulations. It is specially important to remember that pus may be left in the meatus and that it will soon decompose, the most common result of which is ulceration of the drum-membrane with perforation, so that the otitis purulenta is transplanted to the tympanum and deeper parts. Later on we shall speak of the suppurative otitis media and its dangers to the ear and to health.

In other directions than those already mentioned, the pus may make a passage for itself or the inflammation may extend. In older children, who already possess an osseous meatus, caries or necrosis may occur on the walls of that passage, and such a consecutive disease of the bone may result all the more easily since the cutis of the osseous meatus contains the blood-vessels for the bone, and acts thus as the periosteum. On account of this peculiar double nutrition afforded by the lining of the osseous meatus, the otitis externa, if long continued or very severe, may, like a periostitis, affect the nutrition of the bone. A subcutaneous abscess in the osseous canal is, at

the same time, a subperiosteal abscess, and the bone beneath it may be cut off from its nutrition and become necrotic.[1] In order to appreciate further how serious results may be developed within the cranium from diseases of the meatus, it must be borne in mind that the part of the petrous bone from which the mastoid is gradually developed, the transverse sinus and the posterior fossa of the skull with the cerebellum lie close to it, and the dura mater of the middle fossa is not far from the upper wall of the passage.

A special peculiarity of the meatus in young children which has never yet received sufficient notice from anatomists must be mentioned here. Every child of a certain age has a quite large opening in the lower anterior wall of the osseous canal which is produced by irregularity in the growth of the bone at this point. This defect in ossification appears first in the child between the twelfth and eighteenth month, is about the size of a cherry-stone and open towards the edge of the bone, and is still to be seen, as a rule, in the fourth or even fifth year as a round opening which is gradually closing. Its size and the time of its disappearance vary very much. Occasionally it has become filled with firm bone by the third year, and, on the other hand, it is sometimes still present in the skulls of youths.[2] It is evident that this opening, which is covered merely by the skin of the meatus and the periosteum, must

[1] Such a case of necrosis of the anterior wall of the meatus is described by Schwartze in a child two years old (Prak. Beiträge zur Ohrenheilkunde, 1864, p. 8), and another in a girl twelve years old who died from typhus was described by me (Archiv für Ohrenheilkunde, vi., p. 50). Certainly from the long continuance of an otitis externa in early childhood an injurious influence must be exerted on the growth of the osseous meatus and of the petrous bone; we are, however, not in position to formulate this more accurately.

[2] This opening is mentioned by Cassebohm, "Tractatus quatuor Anat. de aure humana," Halle, 1734, p. 28; it is more thoroughly described in Huschke's edition of Soemmering's Handbuch (v. 13, Leipzig. 1844, p. 896); see also author's Lehrbuch der Ohrenheilkunde, sechste Auflage. Leipzig, 1877, p. 18.

be a vulnerable spot, which purulent and suppurative processes may readily break through, forming fistulous openings towards the parotid gland and the region of the lower jaw, so that the inflammation and suppuration may extend to these regions.

In regard to the prognosis of otitis externa, it may be said that, as a rule, if properly treated in its early stages it may be cut short, and in most cases will heal without permanent injury to the hearing or to the ear. With neglect, on the contrary, it may develop a chronic suppuration which may last many years and even for the whole life, and under certain conditions may cause a premature death.

The treatment is extremely simple. In the beginning of a severe otitis externa, if the child is strong, one or two leeches on the edge of the ear-passage, in front of the tragus or upon the cartilage just below it, will be of service. Frequent ear-baths with warm water will relieve the pain and shorten the congestive stage. As soon as suppuration has begun, care should be taken to thoroughly remove the secretion by syringing once or twice in the day; also thin rolls of charpie about one inch long passed into the meatus and renewed hourly or less often, are useful for absorbing the pus.

After syringing, a luke-warm weak astringent may be dropped in and held in the meatus for from five to ten minutes with the head bent, but it is not well to begin with such solutions too early. Zinc sulphate and lead acetate are the most to be recommended. In chronic cases, a disinfectant should be added to the water used in syringing (potassium permanganate, carbolic or salicylic acid) and the astringents should be stronger. Granulations can be shrivelled up by the application of silver nitrate fused upon a probe or by dusting them with pulverized alum.

The parasitic and syphilitic forms of the disease require a special treatment. With large condylomata, in addition

to specific general medication and the most careful cleanliness, removal of the growths with scissors or by destruction with silver nitrate is necessary. If vegetable parasites exist, their thorough removal, together with the masses of epidermis, is necessary, and afterwards care should be taken that the spores existing in the air of the dwelling no longer find a favorable soil in the meatus, and their entrance into that passage should be prevented. For the former object, precede the syringing by long continued ear-baths of warm oil or solutions of soda. When all the growth has been removed, frequent instillations of a dark-red solution of potassium permanganate (1–2%) should be applied so that the skin of the meatus may be covered with a black deposit; dusting with pulverized magnesia, alum, or sulphur, to which a little salicylic acid has been added, effects the same thing. The meatus should also be kept closed for a long time with clean cotton-wool, of which the best is that prepared with carbolic or salicylic acid.

In some cases of very painful otitis externa, the application of a small ice-bag, or of water applications, acts well, but the entrance of the ear should be carefully guarded from the entrance of the cold water by the application of a water-tight protection. It is necessary here to give a warning against warm poultices which, although they relieve the pain in the most marked manner, and hasten profuse suppuration and the relief attendant upon it, yet always produce a decided loosening and maceration of all the tissues, and certainly help to make the suppuration chronic; with them also the inflammation is much more likely to lead to rupture of the drum-membrane, by which the disease is changed to a deeper and much more serious affection. The common vesicants and irritating salves are less injurious than poultices, although liable to produce eczema, and to leave scars; they are, however, of no value.

It is worth while here to give a few rules for the applica-

tion of leeches: the spots to which they are to be applied at the entrance of the meatus should be marked with ink, and to insure the application to the right spot, a leech-glass should be used. The meatus should also be closed with cotton to prevent the blood from running in, and the small wounds should be thoroughly covered with English plaster and collodion in order that they may not get inflamed from contact with the pus and become small ulcers, which are often very painful, and produce consecutive swelling of the tissues in the neighborhood, and even facial erysipelas. In many cases it is very desirable to acquaint the parents with a sure method of checking the bleeding, as leech-bites in the region of the ear often bleed longer than is desirable.

The Diseases of the Drum-Membrane.

Polizer, "Die Beleuchtungsbilder des Trommelfells im ges. und kranken Zustande." Wien. 1865, p. 83. [Translation by Matthewson and Newton, "The Membrana Tympani in Health and Disease," New York.—Author's, "Die Krankheiten des Trommelfells." Wiener med. Wochenschr., 1861, Nos. 9 u. 10; also Lehrbuch. 6. Aufl., 1877, p. 136.—Trautmann, "Ueber den Werth der Ohrenheilkunde für Militärärzte." Arch. f. Ohrenh., B. VII., 1873. —Zaufal, "Casuistische Beiträge zu den traumatischen Verletzungen des Trommelfells." Arch. f. Ohrenheilk., VII. u. VIII.—Schwartze, Pathol. Anatomie des Ohres, p. 45-74.

The examination of the drum-membrane frequently shows an appearance varying from the normal, produced, as a rule, by pathological processes in the external ear or in the middle ear. Independent pathological processes confined only to the drum-membrane are extremely rare, because this membrane possesses no wholly independent nutrition, but is dependent for its blood-vessels and nerves on the neighboring parts, meatus, and tympanum, and it receives many of the tissue-elements of its external and internal surfaces from those parts also. These two surfaces, which are continuations of the skin of the meatus and of the mucosa of the tympanum, and which contain

the vessels and nerves, are especially strongly developed on the child's drum-membrane, so that in childhood a diffuse inflammation confined to the drum-membrane, a genuine myringitis, can scarcely exist except from direct injury.

Very frequently during school life, and the punishments attendant thereon, ruptures of the membrana tympani occur when the column of air over it suffers a sudden and great condensation from a blow of the hand upon the entrance to the meatus. Parents and teachers should have their attention oftener directed by physicians to this unnoticed, but by no means rare effect of a box on the ear. Similar traumatic ruptures of the membrane may be produced by contact of a flying snow-ball upon the ear; they also sometimes occur in bathing if one, in diving from a certain height, accidentally strikes the side of the head with the auricle forcibly upon the water; with whooping-cough, bursting of the drum-membrane has been frequently observed. It is evident that a drum-membrane with the normal and uniform tension of its tissues, and with a free and unconfined mobility, can more readily resist a sudden change of air-pressure, whether from without or from within, than when it has spots of variable thickness and resistance, or when there is some affection of tension and mobility caused by adhesions to portions of the tympanic cavity. For instance, when the Eustachian tube is closed, or there is a collection of mucus in the tympanum, the membrane is more easily torn.

Such a rupture appears as a red line, the edges of which separate from each other when air is pressed in with the mouth closed (Valsalva's inflation), and also when the child blows his nose, both producing a blowing, chirping, or, more rarely, a whistling sound in the ear. The injury is most easily recognized when the rupture runs up and down parallel with the manubrium on the posterior half of the membrane; it may, however, also occur on the anterior part of the membrane, and is then usually smaller.

At the moment when the membrane bursts, the patient feels a sudden, often benumbing pain in the depth of the ear which gradually diminishes, but may remain for several hours; with this there is a dull feeling in the ear, with roaring, ringing, and diminished hearing. A moistening of the meatus with bloody fluid usually occurs, which in some cases becomes visible or even drops from the ear without bending the head. With the rupture, there are sometimes extravasations of blood, and not unfrequently these extravasations of variable extent are the only result of such concussions of the drum-membrane. It is interesting to observe the gradual movement of ecchymoses in the drum-membrane towards the periphery, which can be best compared to the movement of the well-known white spots on the finger nails.

If no deeper complications are present, such wounds of the drum-membrane heal, as a rule, rapidly, without leaving permanent injury, as do also the punctures from needles, straws, probes, etc.; a moderate effusion of blood in the tympanum does not interfere with the healing process. The only thing necessary to be done is to abstain from irritating the edges of the wound or from separating them. A little cotton wool should be worn in the meatus, but only laid in lightly, and not pressed hard, and the patient should be forbidden to blow the nose suddenly and violently. Any existing cough should be moderated by appropriate medicaments. All instillations, syringing, and other interference with the ear are improper, as they will prevent healing by first intention. From any irritation, suppuration easily occurs on the edges of the rupture, which may produce a loss of substance in the drum-membrane, requiring a long time to heal, and such a suppuration may, under certain conditions, produce a suppurative inflammation of the tympanum. Such suppurations, with perforation produced by a box on the ear from the hand of parent or teacher, are not uncommon. Whether at the

time a catarrh or a slight deafness was present on that side cannot, as a rule, be determined; but it is necessary to bear this possibility in mind when a special force in the air-pressure is absolutely denied.

II. THE DISEASES of the MIDDLE EAR,

VIZ., OF THE

TYMPANUM, EUSTACHIAN TUBE, AND MASTOID PROCESS.

Malformations. Buhl und Hubrich, Beitrag zur Entwicklungsgeschichte des inneren Ohres, entnommen aus Missbildungen desselben. Zeitschrift für Biologie, 1867.—Huschke a. a. O., p. 906.—Hyrtl, Vergleichend anatom. Untersuchungen über das innere Gehörorgan des Menschen und der Säugethiere. Prag, 1845. § 23 und Tab. V., Fig. 13 u. 14.—Linke's Handbuch der Ohrenheilkunde, I., 1837, § 372-76.—Gruber's Lehrbuch der Ohrenheilk. Wien, 1870, p. 573.—Schwartze, Pathol. Anatomie des Ohres, pp. 71, 101 u. 109; also translation, l. c.

The Tympanum in Infants and Young Children. Du Verney, Tractatus de organo auditus. Norimb., 1684, p. 36.—Koppen, "Beobachtungen über Ansammlung von Flüssigkeit in der Trommelhöhle Neugeborener." Diss. inaug., Marburg, 1857.—Author's, "Ueber die Häufigkeit von Eiteransammlung in der kindlichen Paukenhöhle." Würzb. Verhandl., 1858, Bd. IX., p. lxxvii. "Die Anatomie des Ohres in ihrer Anwendung auf die Praxis. Würzb., 1861, § 27 u. 28; also in his Lehrbuch der Ohrenheilkunde, 6 Aufl., 1877, p. 170 und XXIII., Vortrag.—Schwartze, Otitis interna purulenta infantum. Archiv für Ohrenheilk., 41, 1864, I., p. 202.—Wreden, "Die Otitis media neonatorum." Berlin, 1868, und "Die Ohrenprobe als Ersatz der Lungenprobe," etc. Vierteljahrschr. f. gerichtl. Medizin, 1875, B. XXI., p. 218. —Zaufal, Sectionen des Gehörorganes von Neugeborenen und Säuglingen." Oesterr. Jahrb. für Pädiatrik, I. B., 1870, p. 118.—Brunner, Beiträge z. Anatomie u. Histologie des mittl. Ohres." Leipzig, 1870, p. 28 —Wendt, "Ueber das Verhalten der Paukenhöhle beim Fötus und beim Neugeborenen." Archiv f. Heilkunde, B. XIV., 1873, p. 97.—Eduard Hofmann, "Ueber vorzeitige Athembewegungen in forensischer Beziehung." Vierteljahrschr. f. gerichtl. Medizin, 1873, B. XIX.—Kutscharianz, "Ueber die Entzündung des Mittelohres bei Neugeborenen und Säuglingen." Arch. f. Ohren-

heilk., 1875, X., p. 119.—Moldenhauer, "Das Verhalten der Paukenh. beim Fötus und Neugeborenen und die Verwendbarkeit der Ohrenprobe für die gerichtliche Medizin." Arch. der Heilk , XVII., 1876, p. 498.

Congenital malformations of various kinds have been very often observed in the tympanum. Of these should be mentioned abnormal smallness of the cavity, absence of the cochlear or vestibular fenestra, or contraction of one or the other by bony tissue. The ossicles sometimes are wanting wholly or in part; more commonly, however, they are abnormally large, or small, or misshapen. The stapes most frequently shows variations from the normal; the two crura may be fused in one, like the columella in birds, or they may be united by a solid mass of bone, so that the stapes resembles a small pyramid, or between the crura there may be a delicate, sometimes perforated plate of bone; in other cases, the crura do not meet at the head, but one stands out free, or one may not reach the base of the bone, or one may be entirely wanting. Absence of the base of the stapes has been observed where the crura united together in the form of a loop without touching the fenestra ovalis.

Other cases have been described of congenital separation of the different ossicles, and, on the other hand also, of immovable union of these bones or of anchylosis of their joints. Most of these congenital abnormities are more common in monstrosities, and more frequently associated with malformations of the external ear than without them.

Absence or closure of the Eustachian tube is described by authors as more common than the few very rare cases which have been thoroughly described justify us in assuming. In regard to the mastoid process, it does not exist in the child as a rounded prominence behind the auricle, but in early life this spot is perfectly flat, and contains only a finely porous, osseous tissue; this gradually curves outwards, and the pneumatic cells, which form the mas-

toid process, and are also found throughout the petrous bone, appear, but only reach their full development at the time of puberty.

It is very important that the physiological condition of the tympanum in the fœtus and new-born child should be understood. So long as the child has not breathed, the tympanum can contain no air. Heretofore anatomists have assumed that at the time of birth the cavity was filled with mucus, which gradually disappeared with the entrance of air during the breathing and crying of the child. This, however, is not so; but the tympanum of the fœtus is filled by the mucous membrane itself which, especially on the labyrinthine wall, is in a marked hyperplastic and swollen condition; while, in adults, the mucosa covering the promontory is extremely thin, almost like a serous membrane, in the fœtus it appears as a thick, gelatinous tissue reaching to the inner surface of the drum-membrane, and therefore almost entirely filling the tympanic cavity. On closer examination, this mucous-membrane-cushion of the tympanum consists of embryonal connective tissue or the mucous tissue of Virchow, viz., of a mucous fundamental substance with a well-developed network of cells; its surface contains blood-vessels, and is covered by a beautiful nucleated polygonal pavement-epithelium.

The important practical question now is, when does this fœtal mucous-cushion of the tympanum disappear? Although I expressed the opinion in 1867 that the diminution began before birth, and Zaufal showed, in 1870, that in children carried to full term, but who had not yet breathed, it could be found only in traces or not at all, Wreden and Wendt have claimed that its disappearance is wholly dependent upon the breathing, and have proposed this as a substitute for the lung test in medico-legal investigations in regard to the extrauterine life of a child when the head only can be examined. This use of the ear in new-

born children, originally only intimated by Wreden, in 1868, was followed up by Wendt, in 1873, in detailed investigations and developed "within certain limits" in several articles which were unconditionally accepted by Wreden, and by him proclaimed with certainty. He says: "The ear-test deserves to be inserted in the text-books on legal medicine as the twin sister of the lung-test." The anatomical basis on which this dogma was founded was not then firmly established, as has already been seen above. Since that time, Kutscharianz, on the basis of very numerous investigations, which were published in Russia, originally in Moscow, in 1872, has claimed (1875) that the mucous-cushion of the tympanum disappears during intrauterine life, while, on the other hand, Moldenhauer asserts that "under certain conditions the embryonal state of the tympanic mucous membrane may continue for several days after birth." The medico-legal examiner will do well not to accept the ear-test as a proof either for or against the fact of a child having lived. Aside from the great seriousness which this question, thus determined with rash certainty by some and echoed already by others, must have in practical life, it is necessary here to examine the evidence in regard to the time at which this tympanic mucous-cushion disappears.

Aside from the pathological processes which are so frequently found in dissecting the tympana of small children, the normal condition of the tympanic mucous membrane in the new-born child should be understood. The condition at this age may perhaps explain some of the pathological cases. As the opinions of different observers are at varience as to the time at which the mucous-cushion of the tympanum disappears, so there are various theories in regard to the mode in which the change in the mucous membrane takes place. While one observer ascribes it to a shrivelling up, increased desquamation, and degeneration of the surface, others speak of its destruction as accom-

panied by the formation of purulent masses; some refer it to resorption of the tissue, while others again assert that it is a transformation of the gelatinous tissue into fibrous connective-tissue substance, taking place sometimes rapidly, sometimes slowly. Be this as it may—probably later all will agree that the mode in which the change occurs varies according to individual peculiarities—it is certain that, at the time of birth, important histological changes take place in the mucous membrane of the human tympanum, so that this membrane, in a child which has breathed, is surrounded by an entirely different medium, that is, it is under totally different influences of circulation and existence from what it was immediately before in utero. It is a generally established rule that organs and tissues are much more liable to disease in those epochs when important physiological processes or sudden changes in the condition of the circulation are taking place, and at these times of increased activity of metamorphosis or nutrition, disturbances in such processes readily occur which lead to pathological changes. Let it be remembered here that intense disturbances of nutrition in the bones occur most frequently during those years in which the skeleton is being developed, and also that diseases of the female genital system frequently begin during the menses or in puerperio.

Although the different observers have reported so variously in regard to the normal condition of the mucous membrane and contents of the tympanum in the new-born child, it is very possible that a portion of the appearances which they have described, are to be attributed to variations from the normal, that they belonged to exceptional or pathological cases.

It should be emphasized here that the labor itself, especially if it continues unusually long, may directly involve danger and injury to the middle ear of the child. Wendt was the first to report that sometimes materials were

found in the tympana of new-born children which originated directly from the amniotic fluid or from the maternal organs (fine hairs, vernix caseosa, meconium, vaginal mucus), and he assumed that they must have reached the ear by the inspiration of the thorax during labor. Ed. Hofmann showed later that, during the birth, and produced by the separation of the placenta, very frequently indeed respiratory movements of the chest occur, with which necessarily inspiration of the media surrounding the child must take place into the middle ear as well as the lungs. That the entrance of a large amount of foreign material into the one or the other organ may act as a pathological irritation, and, under certain conditions, produce a mechanical closure of a narrow cavity, can scarcely be denied.

The result of all these observations renders it certain that the middle ear of children in the latter part of intrauterine life, during birth, and in the first part of extrauterine existence is easily subjected to disturbances in nutrition and circulation, and often exposed to important dangers. It would, therefore, not be at all surprising if pathological processes in the middle ear should be found very common in the first weeks of life, and if some pathological appearances at this age should result from these processes.

In the first few years of life, also, the morphological relations of the child's organism favor the disposition of the middle ear to diseases more than they do at a later period. It should also be remembered that it is well established that, even in adults, among all the affections to which the ear is subject, those of the middle ear occur most frequently.

Attention must here be called to the fact that, in children, the dura mater and the tympanic mucous membrane are in much more intimate connection than is the case in later life. Along the roof of the tympanum and

antrum mastoideum runs the dividing line between the petrous and squamous portions of the bone, the sutura petroso-squamosa. Like all the other sutures of the skull, this is more open in early life than at a later period, and, at that age, the dura mater covering the roof of the tympanum projects into this open fissure, and gives off downwards a marked band or process of tissue, through which there is a direct connection between the dura mater on the one hand and the mucosa of the middle ear on the other, and this connection is not by the vessels only, for this always exists in adults, but by the tissue itself. It is evident that, through this connection of the two regions, all abnormal processes of nutrition and circulation in the one will be easily communicated to the other, the hyperæmias and diseases of the meninges, which are so common in childhood, being readily transmitted to the tympanic cavity, and, on the other hand, the not infrequent pathological changes in the tympanum must always exert a certain influence on the interior of the skull. That this reciprocal influence may be recognized, not only anatomically, but also clinically, in the symptoms under which pathological processes in these regions express themselves, scarcely admits of doubt.

In establishing the degree in which the middle ear in childhood is predisposed to disturbances and disease, we must remember the all-important fact that both Eustachian tubes enter the naso-pharynx. The lining of this cavum pharyngo-nasale or pars nasalis of the pharynx, is known to be more tumid and much richer in blood-vessels and glands of various kinds than the lower or throat pharynx; between the orifices of the two tubes also runs a continuous layer of that peculiar "cystogenous substance" resembling lymph glands (adenoid tissue of Luschka), which reaches its greatest development about the middle of the pharyngeal arch in the tonsilla pharyngea, a soft, spongy, generally fissured prominence resembling a tonsil.

In childhood, all of these mucous, skin, and lymph-gland elements are particularly strongly developed, as is also the throat tonsil in its normal condition; in every coryza and angina, in measles, scarlet fever, and diphtheria, and in the other diseases which are common in childhood, they suffer decided increase in the congestion of their blood-vessels, in their size and in their secreting ability. The tissues of the ear itself may not, at first, be at all involved in the pathological process in the retro-nasal cavity, and yet the ear be placed under abnormal conditions as the result of the hyperæmia and swelling which occur around the orifices of the tubes and close them, the more easily as, in children, the tubal orifices are narrow and slit-like. This closure interferes with the removal of the secretion formed higher up in the tube, and also affects the air inclosed within the tube; for the air contained in the osseous middle ear, if from closure of the tube, it is not renewed, suffers a partial absorption through the vessels and moist mucous membrane, and becomes rarefied; as the result of this, the pressure on the inner surface of the drum membrane is less than that upon the outer surface next the meatus and the drum membrane and the ossicles are pressed inwards. When a diminished pressure is exerted upon the mucous membrane and the vessels of the tympanum, these tissues are submitted to a sort of suction, which produces a sponginess of the tissues and a decided exudation of serum in the tympanic cavity. We thus see that, with every considerable swelling of the naso-pharyngeal mucous membrane, such as is found so commonly in a pronounced degree in children, a number of abnormal conditions may exist in the tympanum and on the drum membrane without the ear itself being primarily diseased. As the mucous membrane of the tube is a continuation of the mucosa pharyngo-nasalis, of course often the inflammatory process extends from the naso-pharynx up the tube per continuitatem, and the mucous membrane of the ear is affected

just as the nasal membrane is. Under such conditions, the closure of the tube with the increased concavity of the drum membrane, with the swelling, hyperæmia, and increased secretion in the tympanum will be more decided and of longer duration.

The hyperplastic and inflammatory affections of the palatine tonsils, so common in childhood, act in a similar way in closing the tubal orifices as, when they attain a large size, they press the palate and the surrounding mucous membrane up against the pharyngeal orifices and, like a foreign body, produce chronic stasis in the blood-vessels and act as a continual irritation to all the neighboring tissues.

Finally it must be remembered that the current of air with both in- and ex-piration passes the naso-pharynx and goes wholly this way whenever we breathe with the mouth closed. The naso-pharyngeal cavity, in which the two orifices of the Eustachian tubes lie, therefore belongs especially to the respiratory apparatus—a relationship which, although so evident, has scarcely been appreciated by physicians. Abnormities in the respiration may thus act upon the ear, and, on the other hand, the character of the inspired air may influence the mucous membrane of the naso-pharynx, and thus indirectly the ear.

The Eustachian tubes are, to be sure, closed when at rest, under normal conditions the moist mucous surfaces lying in light contact. This closure of the tube ceases on contraction of the muscles which have the power of acting upon the movable portion of the cartilaginous tube, as occurs in swallowing and gaping; it also ceases from the mechanical pressure of air or of fluid when these are driven with a certain force so as to separate the mucous surfaces from each other. The best known method of accomplishing this latter process is Valsalva's experiment, which consists in taking a long inspiration, closing both mouth and nose, and attempting to expire forcibly; the

air from the thorax, its exit being prevented, will force open the closed tube, if the resistance of the tubal walls is not too great, will pass up into the tympanum and in favorable cases will press the drum-membrane outward. Just the opposite of this effect is produced by swallowing with closed mouth and nose—the Toynbee experiment; with this, the air in the tympanum is rarefied, and the drum-membrane is drawn farther inward. The same effect, which is produced voluntarily and intentionally with these experiments, occurs very frequently involuntarily from variations in the pressure of the air contained in the naso-pharynx, as in blowing the nose, sneezing, and coughing. In such expiratory efforts the closure of the tube is readily overcome, and the air in the pharynx is momentarily in direct connection with that in the osseous middle ear, as can be proven by inserting a manometer in the meatus, or frequently also by watching the changes of position of the drum-membrane.

This action upon the ear of a varying density in the air of the pharynx will take place the more readily if the tube is easily permeable, that is, if its walls are not very firmly and intimately stuck together, also the more forcible and sudden the expiratory efforts and the smaller the naso-pharynx; a decided condensation and rarefaction of the air in the ear will occur also if the nasal cavity is narrowed or closed, since the mass of air from the pharynx cannot then pass readily forwards and outwards through the nostrils.

Several of the conditions favorable to the entrance of the respired air into the ear always exist in children, as for instance, coughing, etc.; others occur very frequently. Although the pharyngeal orifice of the child's tube is narrower and less open than it is in adults, the portion of cartilaginous tube just above the orifice is not only relatively, but absolutely wider than in later life: the closure of the tube is therefore more lax and more easily over-

come, as will be seen later when we come to speak of Politzer's inflation. From the lesser dimensions of the skull the naso-pharynx of the child must be decidedly smaller than in adults, and its air space is also in the normal condition diminished by the greater thickness and succulence of its mucosa; in catarrhal and hyperæmic conditions, this diminution must naturally be increased. It is unnecessary to more than call attention to the fact that, not only at the age when the use of the handkerchief is an unattained art, but all children are very frequently afflicted with impermeability of the nose, sometimes from swelling of the mucous membrane, sometimes from collection of mucus in the nostrils. From all of these facts, it is evident that, particularly in childhood, violent and rapidly recurring respiratory movements, such for instance as attacks of whooping cough, may easily have an unfavorable influence upon the tympanum and drum-membrane, and it is doubly necessary to see in such cases that the nostrils are kept as free and open as possible. With a closed nose every movement of swallowing must also carry out the Toynbee experiment, by which the air in the tympanum is rarefied and the drum-membrane drawn further inwards; consequently every act of nursing produces the same condition in the ear which a closure of the tube does.

All of the conditions which we have been considering above as favoring the entrance of air into the child's ear with each forcible expiration, naturally also favor the entrance of fluids, whether they reach the naso-pharynx from in front, as in dipping the head under water and as in the use of the nasal douche; or from below, as in vomiting. Inflammation of the tympanum and deafness, following vomiting, may be produced by the entrance of the contents of the stomach into the Eustachian tubes, for some of the vomited material passing up behind the palate, involuntary swallowing movements with sneezing and coughing over-

come the closure of the tube, and press the injurious ingesta upwards; such cases may occur with tussis convulsiva where the cough is so often associated with vomiting and choking. It is also possible to imagine that in a child, where the isthmus tubæ is but little developed, any secretion, either fluid or in small lumps, which was present in the naso-pharynx or in the lower part of the tube, might by strong and repeated expiratory efforts be pressed into the tympanum.

In considering the nose and pharynx as part of the respiratory tract, we must call attention further to the injuries which the inhalation of impure air has upon their mucous membrane and indirectly upon the ear. Children living in crowded nurseries, which are also used as water-closets and also often for cooking, drying of linen, etc., and those who frequent overcrowded and unventilated school-rooms are subjected to a bad and, for the purpose of breathing, unserviceable air—an evil which is receiving more and more attention, at least in hygienic writings. Too much stress cannot be laid upon the evil effect which too warm, too damp, or impure air in the house and in the school, exerts upon the health of the child—an effect which is most directly exerted upon the nose and pharynx with which it is first brought in contact, and upon the extensive lining or mucous membrane of which a large part of the dust and of the superfluous water, and of the gases from the surrounding atmosphere are deposited. If the majority of the severe diseases of the nasal and pharyngeal mucous membrane, of continuous cold in the head, of angina, croup, and diphtheria, occur in childhood and during school life, the reason is, that at no other time of life are these regions subjected in such a violent manner to the injuries produced by the continuous inhalation of foul air; it is not intended to state, however, that parents, teachers, and even physicians are fully advanced to this view of the subject. The manner in which irritation and

swelling of the mucosa of the nose and pharynx influence the ear, especially in children, has been already described.

As a synopsis of the points which have been brought forward in the last few pages, it may be asserted as a fact that, in childhood, aside from a few weeks immediately following birth, an unusually strong predisposition to diseases of the middle ear exists, owing on the one hand to the double influence of the peculiar morphological relations of the ear and the pharynx, and on the other hand to the diseases and conditions of life to which the child is frequently exposed.

This conclusion has been reached through reflection and induction chiefly by placing together well-known facts. The question now is, how far this agrees with experience based upon observations on the living and upon dissections. The demonstration can as yet only be produced piecemeal, but this need excite no wonder, for how long is it since the diseases of the ear have been submitted to a thorough and scientific investigation in large numbers? Have those physicians, who have made the observation and study of children's diseases their special life-work, taken part in the work either in large numbers or with productive results, or have they rather contributed only imperfect and sparse contributions to the development of this portion of special science? The latter is undoubtedly the fact. In what a wonderfully slight degree the interest of children's physicians in general is developed in regard to diseases of the ear is shown, above all, by the fact that the increasing number of reports on the frequency of pathological appearances found in the ear upon dissection are often considered scarcely worth a description from a pædiatric point of view, to say nothing of a thorough investigation. This can be explained partially by the peculiar difficulty which exists in recognizing

the non-suppurative diseases of the ear in children; the natural result of this is, that the appearances on dissection do not receive an exhaustive investigation or clinical appreciation.

In reviewing shortly these remarkable and not yet clinically appreciated dissections of children's ears, it will be found that the oldest notice of them is that of Du Verney, who wrote two hundred years ago: "Aperui etiam complurium infantum aures, in quibus tympanum excrementis erat plenum, interim nunquam, neque in cerebro, neque in osse petroso, inventâ ullâ pravâ dispositione." In later times, there will be found, in Koppen's Marburger Dissertation of the year 1857, a statement which is applicable here; he examined only new-born children—the oldest twenty-five days old—and found the tympanum empty in six, while in eighteen that cavity contained fluid, and in four of these eighteen, the fluid was true pus.

Without any knowledge of these preceding statements, I called attention in 1858 to the frequency of collections of pus in the tympana of small children. In forty-seven petrous bones taken from twenty-four unselected children out of the polyclinic or the lying-in hospital, in the course of several years, I found the middle ear normal in only eighteen; the other twenty-nine ears showed in various degrees the appearances of a purulent, rarely of a mucous catarrh. Masses of pus filled the cavities so far as the loosened and hyperæmic mucous membrane left any cavity; the drum-membrane was never perforated. Of the fifteen children with exudation in the middle ear, the youngest was three days, the oldest one year old; five were in their first month; two each in their second and fourth; three in their third; and one each in the seventh, eighth, and twelfth month. The rest of the examination offered nothing peculiar; the children were generally poorly nourished, and the common diseases were atrophy, intestinal catarrh, frequent atelectasis of portions of the

lungs, and bronchitis; venous hyperæmia and congestion of the brain were always present when that part was examined.

According to Schwartze (1864), for every five examinations of new-born children, in two the tympanum will be found filled with pus. Of three cases which he describes, one was three months old; in two of the three there was marked hyperæmia of the labyrinth, and in one of these the cochlea was full of pus. He emphasizes the fact that obstructions in the respiration or in swallowing may be of importance in the pathogenesis of these suppurative processes.

Wreden (1868) found in eighty ears which he received in the course of four months from the St. Petersburg Foundling House, a normal middle ear in only fourteen, while purulent catarrh existed in thirty-six, and simple mucous catarrh in thirty; in four of the cases, pus was also present in the labyrinthine cavities. The youngest child had lived twelve hours, the oldest fourteen months, although all were classed as otitis neonatorum; the majority of the cases were, however, from three to fourteen days old. In most of the cases, the accounts of the autopsies showed, in addition to the pathological condition of the ears, marked diseases of the respiratory organs (pneumonia thirty-six times, atelectasis congestiva sixteen times, etc.); but hyperæmia meningum was also found eleven times, œdema meningum eight times, meningitis suppurativa three times. As an explanation of the pathological condition in the middle ear, Wreden also called attention to the injurious influence which obstructed or weakened respiratory movements or disease of the pharyngeal or nasal mucous membrane must exert upon the middle ear, and also to the intimate anatomical relation which exists between the cavities of the skull and the tympanum.

Edward Hofmann (1873) examined in Innsbruck twenty-four petrous bones from children varying in age from

thirty-two hours to four weeks, and found the tympanum filled with pus in seven cases, while in the other seventeen it was perfectly or nearly normal.

The greatest number of investigations have been made by Kutscharianz (1875 and 1872) from children out of the Moscow Foundling House, the ages of which varied between a few days and seven months. From about two hundred and thirty accurately described cases, the tympanic mucous membrane was normal in only thirty, in fifty it showed either a slight or intense catarrhal inflammation, and in one hundred and fifty the tympana were filled with yellowish-green pus, with occasional clumps of mucus mixed with blood; in four of these cases of purulent inflammation, the pus was of an ichorous character.

These very astonishing results of the dissection of children's ears would undoubtedly have received more attention clinically, and have been of greater influence on the views of physicians, if they did not unfortunately deal, almost without exception, with little children before the end of their first year. The reason of this, however, is evident, and is due to the great mortality in children at this age, and also to the fact that the material used was derived from foundling and lying-in hospitals. It is to be wished that physicians who serve in hospitals for children of an older age would examine, through a long space of time, the middle ears of those children who die after the first year of life, in order to determine whether, in the later years of childhood, pus and mucus in the tympanum with a congestive swelling of the mucosa occur more frequently than has been thought from our present knowledge of the pathological appearances.[1] Then the

[1] So far as I know, the observation of the late Prof. Streckeisen, of Basle, which is quoted in full in my Lehrbuch at the end of the twenty-third chapter, together with the autopsy of the six-year-old child, stands alone; in this case, the child died with cerebral symptoms, and the autopsy showed a well-developed otitis media purulenta.

explanation which is now so often heard, that in these examinations of children a normal and physiological, and only apparent pathological condition, was found, would be gradually silenced.

It is true that some of the anatomical and histological appearances in infants, especially in those organs which play a different rôle post partum from what they did previously in utero, do not have the same meaning with similar appearances at a later age, and some of the processes of development of portions of the new-born child still await definitive settlement and recognition. Further, in the tympanum special care in the interpretation of the appearances is necessary, since here the most elementary conditions of life become, on the one hand, totally changed with the birth, and, on the other hand, the modality of the changes which take place in the organ are described by different observers in a contradictory way. The dividing line between the normal and the certainly pathological condition is in this question the less sharply to be determined at present, as the birth and the earliest days of life produce disturbances in the physiological processes in the ear very frequently indeed. If it is considered as demonstrated that the tympanum is filled with embryonic mucous tissue at the time of birth, we may assume that Zaufal is right in considering that the pus which is found in the tympanum a few days after birth is chiefly not an inflammatory, but a degenerative product of the embryonic tissue retained in the cavity owing to some impediment in the tube. The more energetically the motions of breathing, nursing, and swallowing are carried on by the new-born child, the more rapidly will these normal degenerative products be carried downwards to the pharynx; while with any disturbances in the respiratory tract, especially with diseases of the mouth, nose, and pharynx, they are readily retained in the ear, and by their presence may produce irritation and inflammation. Brun-

ner also has expressed the opinion that the existence of pus in the majority of cases is a physiological retrogressive process.

The possibility of this interpretation of the pus, however, is untenable, if it is assumed with Kutscharianz that the cushion-like prominences of the tympanic mucous membrane wholly disappear during the latter months of intrauterine life, and do not exist in the infant at full term—a condition which Zaufal also found in one still-born infant and also in another carried to full term, but which had never breathed. The interpretation of the pus as a physiological retrogressive product is likewise impossible, if, with Wendt, we deny the existence of a tissue degeneration, and assume that the disappearance of the swollen mucous membrane occurs through a higher differentiation, through a transformation of the gelatinous tissue into fibrous connective substance—an opinion to which Moldenhauer has committed himself. Probably the time and the method of the change in the original tympanic mucous membrane occur in various ways, according to the innumerable conditions of growth, nutrition, and life in which the infant lives in the uterus, during the birth and immediately after that event, so that it is extremely difficult to separate with absolute certainty the rule from the exception, especially considering the frequency of insidious and retarding influences.

However this may be, pus in the tympanum can be regarded as the direct or immediate result of physiological processes only for a short time after birth. Zaufal and Brunner made their examinations entirely at this age. Zaufel reports the examinations of nine ears, taken from six infants, two of which were new-born, and the oldest was three weeks of age; Brunner examined three from new-born infants and three from children under five weeks of age. If mucous or purulent masses are found in the tympana of children who have lived some months, it is

impossible to explain its existence by the fœtal conditions developed at or immediately after birth. Of twenty-nine ears, in the tympana of which I found an abundant exudation, nine were of the first month, four of the second, and six of the third; the other ten were from children between the fourth and twelfth month, and this increase with the increasing age certainly prevents our considering the condition as one belonging to the new-born child, and also forbids our regarding the anatomical changes as in any way connected with processes occurring at the time of birth. The cases of mucous and purulent collections described by Wreden and Kutscharianz were partially those of children after the third month, some even as old as the seventh and fourteenth months. What is there to justify us at such an age in speaking of a natural and physiological condition, when a cavity, which should normally contain air, is filled with mucus or pus? When a mucous membrane, which normally is smooth, thin, and slightly vascular, is found very much thickened, succulent, and hyperæmic?

Such appearances from their very nature must be regarded as pathological and deviations from the normal; and this view is further sustained from the fact that, according to the reports of all those who examined large numbers of petrous bones from children, this pathological appearance of secretion and hyperæmic swelling was not universally found, but in a certain proportion of cases the tympanum was free and really in its normal condition. As would be expected, the numerical proportion between normal and pathological tympana varies very much in the different reports; of the ears examined by me in Würzburg, 38% were normal; of those by Wreden in St. Petersburg, 17½%; by Hofmann, in Innsbruck, 7c%; and by

Kutscharianz, in Moscow, only a little over 13%,[1] showed tympana without hyperæmia of the mucous membrane.

We are justified, then, in assuming, from the description of dissections during the first year of life, which have been furnished in very large numbers, that in children inflammatory and exudative processes in the middle ear are extremely common. It is, therefore, our province to describe the appearances under which they show themselves, and by which they may be recognized. We shall first describe the acute and then the chronic forms of tympanic catarrh.

The Acute Inflammation of the Middle Ear or Acute Aural Catarrh. Otitis Media Acuta.

It is well-known that the inflammatory products of mucous membranes are seldom purely purulent, purely mucous, or purely epithelial in character; more commonly in the secretion there is a mixture of these various elements, but in different cases they are found in very variable quantities, and usually appear mixed with serum and blood. Although in otitis media we should be fully justified in separating the severer forms, where the pus predominates, from the lighter varieties of inflammation, which produce only a mucous or abundant epithelial excretion it is better in this place, where we are dealing chiefly with a succinct account of the most important points, to describe both degrees of the catarrhal inflammatory process together, especially as childhood is particularly predisposed to the production of pus, and therefore in acute cases at this age a catarrh, in which the secretion is chiefly or entirely mucous, is much more rare than in adults. It

[1] On page 408 of the sixth edition of my Lehrbuch, these figures are given as 23%, because I was mistaken in the total number of petrous bones examined by Kutscharianz, considering the number three hundred, while, in fact, he only used two hundred and thirty in deciding this question, the remainder being used in determining the condition of the tympanic cushion in the fœtus and new-born child.

should also be remembered that specific processes, to which the mucous membrane of children is specially predisposed, may be localized in the ear, although such usually occur in the parts of the mucous membrane lying next the pharynx. According to Hermann Wendt,[1] in one-fifth of all cases of croup and diphtheria, and in two-fifths of those cases in which the naso-pharynx is affected by these diseases, the specific process has affected the middle ear. "There was found, always on both sides, a tubular croup-membrane or a solid exudation in the cartilaginous tube. In only one case, the membrane had reached on each side the tympana and mastoid cavities and affected the covering of the ossicles. With the exception of this one case, only hyperæmia of the mucous membrane and hemorrhage was noticed in the osseous middle ear. In the remaining cases of croup and diphtheria (with and without the formation of membrane in the naso-pharynx), there was in some cases catarrhal, in others purulent inflammation of the tympana, in others merely hyperæmia, and in others still a perfectly normal appearance." Wreden had before this (1868) described in eighteen cases a diphtheritic inflammation of the middle ear in the course of scarlet fever which was associated with diphtheritis of the nose and pharynx. He also describes an otitis gangrænosa, which occurs in very anæmic children, and especially in those which are the the subjects of hereditary syphilis.

All of these forms, varying in their course and in the prognosis according to the mild or intense character of the inflammation, according to the benignity or the malignancy of the general disease in the individual, and according to the complications, we will endeavor to unite under the designation of acute aural catarrh or otitis media acuta.[2]

[1] "Diseases of the Naso-pharynx and Pharynx." Translation of Ziemssen, vol. vii., p. 291.

[2] We can use this short name, as the tympanum is the only part of the ear

This process is characterized by a more or less decided hyperæmic swelling which comes on rapidly and extends over the mucous membrane of the whole middle ear; as the result of this, an abundant secretion of inflammatory products of one kind or another takes place so rapidly that within a short time the cavities previously containing air are filled with the swollen mucous membrane and with the secretion, and simultaneously a closure of the middle ear from the pharynx occurs. The inflammatory process sometimes affects equally all the different divisions of the middle ear, the Eustachian tube, the tympanum, the antrum mastoideum, and the mastoid cells[1] so far as they have been developed; more commonly, however, some one portion is more intensely inflamed than the other portions. The more the otitis media is an extension of inflammation from the naso-pharynx, the more decided will the affection of the Eustachian tube predominate, as the mucous membrane and the glands are much better developed at this portion than they are higher up in the tympanum. That such a disease of the tube, even when that alone is the part affected, should put the tissues of the middle ear under abnormal conditions has already been shown in that the drum-membrane is by such a disease forced inwards, and the mucous membrane of the osseous cavity is submitted to suction on

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lined with a mucous membrane, and therefore the only part which can be affected with catarrh. The improper expression so often seen, "catarrh of the meatus" arises from false anatomical knowledge, and would be allowable only if the meatus was lined with mucous membrane.

[1] As is well known, we distinguish in the mastoid process of an adult, first, the antrum mastoideum, a constant round cavity the size of a cherry-stone which lies above and behind the tympanum and communicates with it by a large opening; second, the mastoid cells proper, which extend more downwards and towards the outer surface of the mastoid and contain numerous air-cavities separated by partition walls. In the child, the mastoid antrum, lying directly beneath the tegmen tympani, exists in almost its full size, but the position of the cells is occupied by a thin spongy bone-substance, and a thin bony plate behind the auricle, which only develops into the usual prominence at the age of puberty.

account of the diminished air-pressure in the cavity, as the result of which the tissues become relaxed and there is an increased secretion of serum in the tympanum.

This form of otitis is most commonly developed as the result of intense swelling or acute inflammation of the mucosa of the pharynx or naso-pharynx, these primary diseases occurring in the form of the common angina and coryza or produced by an acute exanthema, measles, scarlet-fever, or small-pox, or else resulting from an hereditary lues, or from the localization of a croupous or diphtheritic process in these parts of the ear. In addition to these diseases, any severe affection of the respiratory organs, most frequently pneumonia or bronchitis, may be the cause of the ear disease. Frequently disturbances of the circulation which influence mechanically the supply of blood and the nutrition of the pharyngeal and aural mucous membrane, such for instance as increased tension in the arterial system from Bright's disease,[1] cause this otitis, and to this category may be referred some of the cases of deafness which occur with the albuminuria following scarlet fever. Venous hyperæmia in the head and its mucous membranes, due to obstruction in the vena cava superior, is more likely to lead to chronic than to acute processes in the ear.

As a matter of course, there may be also an otitis media acuta from general or local influences without any disease of the nose or pharynx existing. Thus with typhus, scrofulosis, or tuberculosis there is often an idiopathic suppuration of the tympanum. From injudicious treatment and especially from the long-continued use of hot cataplasms, producing a maceration of the drum-membrane, an otitis externa may extend inwards; not infrequently also, suppu-

[1] Pure hæmorrhagic inflammations of the tympanum have been observed by Schwartze (Archiv für Ohrenheilkunde, 1869, Vol. iv., p. 12), and by Wendt (idem, p. 261) accompanying retinitis apoplectica with extravasations in the retronasal mucous membrane and in the pharyngeal tonsils.

rative inflammation of the external and middle ears results if, in making applications of ice to the head, the cold water, in any quantity and for any length of time, is allowed to drop into the unprotected ear. Arterial and venous hyperæmias within the skull may also affect the ear by means of the numerous connections of the vessels and tissues which exist between the two along the fissura petroso-squamosa in the thin roof of the tympanum—a relationship already described as very marked in childhood. It is evident that when, as the result of such a communicating fluxion or stasis, the blood-vessels of the tympanic mucous membrane are overfilled with blood, abnormal swelling and succulence of the tissues with an increased formation of young cells and an increased secretion of serum must take place. From the very great frequency of disturbances in the circulation and nutrition within the skull, especially during childhood, it is very possible that extension from the dura mater is, next to that from the pharynx, the most common cause of otitis media in children.

What now are the symptoms by which such an inflammatory process behind the drum-membrane can be recognized in the child? Externally and in the meatus, there is naturally nothing to be noticed so long as no rupture of the membrane and no discharge of mucus or pus has taken place. Inspection of the drum-membrane, which in adults shows us appearances all-sufficient for the diagnosis, is in children made very much more difficult by the narrowness of the meatus and the great inclination of the drum-membrane, which is seen in strong perspective foreshortening and very much reduced in size; at such a time also, the membrane is covered with thick layers of epidermis and cutis, so that it is less glistening and transparent than usual, and the condition behind it can seldom be made out. Secretion within the tympanum can rarely, in the first year of life, be seen through the membrane. The first thing noticed on inspection is the decided congestion of

the vessels which run from the upper wall of the meatus on to the drum-membrane, above and behind the short process of the hammer. When the position and external surface of the drum-membrane more nearly approach the condition usual in adults, as in older children, inspection gives more certain appearances. If the patient is seen in the very beginning of the disease, in addition to the coarse injection of the external vessels of the hammer and the usual intense redness of the neighboring parts of the osseous meatus, there is a slight or well-marked redness over the whole drum-membrane, due to the hyperæmia of its inner mucous layer or else of the opposite labyrinth wall. As exudation occurs, the appearance is gradually changed; the drum-membrane, as the result of serous infiltration, loses its translucency and external glistening, so that it appears dull-gray with some red vessels. As the loosening of the external epidermal surface increases, the manubrium of the hammer, heretofore visible as a yellowish line in the middle of the membrane, becomes indistinct, and finally its position is only recognized by a reddish line of vessels accompanied sometimes by irregular ecchymoses. That an abundant secretion is present in the tympanum is in children made apparent most commonly in the posterior upper quadrant of the drum-membrane which bulges out as a yellowish or gray prominence easily recognized even by the inexperienced; in addition to this, just as in adults, single large radiating vessels are seen in the lower half of the membrane, the remainder of the membrane being very much drawn inwards. For making out all of these conditions, a plain hand-mirror, such as is to be found in nearly every house, is sufficient; with this, sun or lamp light can be thrown into the ear.

Not infrequently, swelling of the lymph-glands is found, not only on the side of the neck when they are dependent upon inflammations of the nose and throat, but also directly behind the auricle where one or more of them always ex-

ist close to the bone. Sometimes the region in front of the auricle is swollen or sensitive to pressure, owing to a secondary infiltration of the glandulæ lymphaticæ auriculares anteriores which lie in the tissue of the parotid.

Observing further the symptoms of acute exudation in the middle ear, it follows as a matter of course that the function of the organ, the hearing, must be the more impaired the greater the amount of swelling in the mucosa and the more abundant the adhesive secretion is upon the drum-membrane and around the ossicles. In many cases, the degree of deafness for the voice and for the watch can be quite accurately determined; but to do this, a certain age and a normal sensorium are necessary in the patient, and above all else it is important that the possibility of the existence of an ear-disease should have occurred to the physician. Very frequently indeed this possibility and the actual existence of deafness is overlooked, and the whole array of symptoms interpreted in another direction.

It frequently happens, especially in childhood, that an acute catarrh begins first in one ear and later extends to the other. If the hearing of one ear is good, it is necessary that this should be closed, as otherwise neither the patient nor friends will recognize the one-sided deafness. Even when both ears are affected, and where in adults the deafness would be immediately noticed, in children such is by no means always the case. Without considering children under a year old, whose hearing only exceptionally has any demands made upon it or can be estimated, throughout childhood so little and so undecided an amount of hearing is required that parents themselves, otherwise observing, first suspect that the child does not hear quickly from the fact that the progress in acquiring language is too slow. Moderate degrees of deafness are almost always detected first in the school, and even then not immediately. "The child is so absent-minded," or "he has the bad habit of asking twice;" with these explanations of parents and

teachers such a diminution of the hearing in a child is often concealed for years which in adults could scarcely remain undiscovered as many days.

When a child several years old is confined with a febrile disease, any tests for the hearing are used only at a very short distance from him, so that as long as he answers the questions of the attending physicians and of the attendants when they are near him, a quite decided diminution in the hearing power may perfectly well remain unobserved and undiscovered. If the answers no longer correspond with the questions and with the grade of intelligence of the child, or if no answers are given to questions asked, it is natural that this, in a child prostrated with disease, sometimes in a state of pathological irritation or in a half-sleep, should be considered as inattention due to the effect of the disease and fever upon the sensorium; so long as no other symptoms point to the process going on in the ear, the thought will occur only in very exceptional cases that this "inattention" may be due to an abundant secretion behind the drum-membrane and to the resulting deafness. The younger the child the less it is able to observe and express itself; the less the physician and family have had to do with deaf persons the easier and the longer may such a deafness, due to peripheral and not central disease, be unnoticed. Similar mistakes are sometimes made with adults and are not confined to unilateral disease.

In addition to this, exudative processes in the tympanum are not always accompanied by decided pain in the ear. The disturbances of sensation may be confined to a dull, heavy feeling in the region of the ear or in the head in general, or, on the other hand, if pain is present, it sometimes is very severe over the entire half of the head, or referred especially to the vertex or to the frontal prominences without being present in the ear. Only when, after inflation of air through the catheter, or after paracentesis or spontaneous rupture of the drum-membrane with

evacuation of the secretion, the head feels entirely differently, is it evident to the patient that all the disagreeable feelings proceeded from the ear. This occurs not only in adults who are able to observe their feelings, but even in physicians themselves.

How much more unfavorable for the diagnosis of such a process in the ear is the condition of things in a child where, aside from the action of the fever and the general disease upon its delicate nervous centres, the capability of distinguishing and localizing feelings is slightly developed. It is also highly probable, from the very intimate connection in children between the dura mater and the tympanic mucous membrane through the arteria meningea media, that the symptoms of cerebral pressure with them are specially prominent, and on the other hand it is very likely that the tension of the soft parts of the ear produced by the secretion is less than in adults, owing to the relatively greater width of the Eustachian tube, and hence the exudative inflammation is less frequently accompanied by severe pain. It should be stated here that the danger to the drum-membrane is in this disease slight, for dissections show only exceptionally a perforation of the membrane in young children, while in adults, as a rule, it occurs early in the disease.

It is hardly necessary to emphasize the fact that, even when very severe pain is present, it is very often, if not generally, difficult of recognition not only in those who are not old enough to express their feelings, but also in older children where it is masked by the general disease and the insensibility of the cerebrum. The child screams and cries whenever anything unpleasant occurs or it suffers pain; it is no easy task for the physician or the parents to discover the cause of these manifestations. Ear-aches are well known to be often extremely severe and continuous, and it is not wonderful that the cries of the child produced by them should be loud and bitter,

and that they should continue with slight intermissions for hours till the little patient is completely prostrated and hoarse. In affections of the lungs, the pleura, and the larynx it is impossible for children to cry loudly or continuously, and the same is true in diseases of the intestines and in meningitis. Confusion with these diseases can, as a rule, be avoided without difficulty by observation of the other symptoms. For making a local diagnosis of the cause of the screaming and crying, it is necessary to observe under what conditions the expressions of pain are increased or diminished. Complaints due to otitis media would certainly be increased by any concussions of the body, by rough movements of the head, by swallowing, and by nursing. The child, after several attempts producing increased pain, refuses the breast or the bottle, while it may perhaps allow the accustomed nourishment to be given slowly with a spoon. Noise and cold will certainly be unpleasant, while on the other hand perfect quiet and warmth either by covering the ear, by frequent instillations of warm water, or by a continuous breathing into the ear, the mouth being laid close against it, will diminish the pain. Vomiting and sneezing will momentarily increase the pain very much, but may be of actual advantage to the ear by, in certain conditions, evacuating the secretion.

In adults, an intense otitis media acuta always produces an increase of temperature with fever, and in addition a dull, numb feeling in the head which may increase to severe and long-continued vertigo ; with these symptoms there may be an extremely irritating, usually pulsating, noise in the ear, resembling a pounding or ringing, which leads to well-defined hallucinations of hearing, so that the whole disease gives the impression to the physician that he has to deal with a febrile congestion of the brain rather than with an exudative aural catarrh, especially if he is unaccustomed to refer such intense symptoms in the general condition to an ear disease. How

natural it is that, with the exceedingly impressionable brain and spinal cord of a child, all of these "nervous" symptoms produced by an exudative inflammation of the middle ear should be much more marked, and that in a child the confounding of the ear disease with a meningitis should really be very easy. The symptoms of the ear disease, great increase in the pulse and temperature, with frequent vomiting, constant stupor bordering on complete loss of consciousness, irrational talk and screaming, great restlessness with an anxious opening of the eyes before which objects move, and the condition of irritability increasing to twitching of the facial muscles and to convulsions of the limbs, all tend to lead one to expect rather an internal affection than an ear disease.

That the symptoms of the exudative aural catarrh preceding the rupture of the drum-membrane and the appearance of an otorrhœa may be mistaken for cerebral manifestations, and that in children these symptoms generally resemble a meningitis, is acknowledged by all physicians who have yet carefully examined the question. Many years ago, Schwarz of Fulda[1] so expressed himself in a decided manner, and Ludw. Meissner[2] wrote, "The inflammation of the ear is certainly one of those diseases which is most frequently overlooked in young children, as they are unable to define the seat, the kind, and the severity of the pain." Most commonly it is mistaken for inflammation of the brain. Helfft[3] compared the symptoms of inflammation of the inner ear in young children to those of a genuine meningitis. Hauner[4] expressed himself later in a similar way. Streckeisen in his "Bericht über den Kinderspital in Basel, 1864," says, "In the pneumonia of infants,

[1] "Ueber die Ohrenentzündung der Kinder." Siebold's Journal für Geburtshilfe, 1825, v., p. 160.

[2] Lehrbuch über Kinderkrankheiten. Reutlingen, 1832.

[3] Journal für Kinderkrankheiten. December, 1847.

[4] "Beiträge zur Pädiatrik." Berlin, 1863, i., p. 227.

convulsive symptoms showed themselves usually in the last three days (of life), and the explanation of these was found on dissection to be purulent inflammation of the tympanum and its meningitic connections." The most valuable contribution is that of Steiner,[1] as it concerns older children; he expresses the opinion that the chief cause of brain symptoms in the so-called cerebral pneumonia is a simultaneous purulent inflammation of the ears, as he observed in sixteen children aged from five to ten years, that with pneumonia of the apex the brain symptoms (a comatose delirium) disappeared as by magic on the appearance of a discharge from the ear. As the chief symptoms, which continued in variable intensity till the appearance of the otorrhœa, Steiner enumerates "vomiting, somnolence alternating with great restlessness, delirium, expressions of pain in the head, a dulled intellect or complete loss of consciousness."

There can scarcely be any doubt that these phenomena of pressure upon and irritation of the central nervous system, which constitute the cerebral symptoms with acute otitis media, may easily mislead the physician and also obscure the peculiar aural symptoms, such as deafness, ear-ache, and tinnitus. If all the specific symptoms referable to the ear are wanting, and the symptoms which are present resemble those of intracranial disease, the diagnosis of otitis media acuta may be extremely difficult in children who are unable to talk or who are in a state of stupor, so long as no pus can be recognized behind the drum-membrane or in the meatus. The existence of some complication, as a nasal or pharyngeal catarrh, an acute exanthema or a pneumonia, would frequently lead one to suspect disease of the ear, and this, with the already described means of diagnosis, would lead to the trial of such medication as would assist in the evacuation of secretion from the naso-pharynx and from

[1] Jahrbuch für Kinderheilkunde, 1869, ii., 4.

the middle ear. As in the cases described by Steiner, the cerebral symptoms immediately disappeared when the pus in the middle ear had established an outlet through the drum-membrane, so, in the same way, the symptoms of pressure and irritation produced by the tympanic secretion would certainly be diminished if care was taken that a part of the inclosed muco-pus could escape through the Eustachian tube. Such attempts are the more to be advised as they will do no harm, even if there is no disease of the ear.

For this purpose, Politzer's inflation is valuable, not only as a therapeutic, but also as a diagnostic agent, and is therefore described briefly in this place. It consists in a condensation of the air in the naso-pharynx by a strong inflation into that cavity, while the nostrils are closed with the fingers. With adults, it is necessary that they should, at the same moment, swallow, in order that the raised palate may close the naso-pharynx behind, and also because the act of swallowing opens the Eustachian tube, and thus furnishes a passage for the air into the tympanum. In children, however, this swallowing is not absolutely necessary, because the naso-pharynx is so small that the condensation of the air is greater than in adults, and because also the tubes are in children relatively wider than in adults, and the action of the compressed air can therefore more readily reach the ear. Children in whom this method of inflation is used also, as a rule, contract the muscles, and so unconsciously raise the palate. Instead of a rubber reservoir for the air, as is generally used, with a firm nozzle to be inserted directly backwards into the nose for the distance of about one centimetre, a short rubber tube may be used, the two ends of which are furnished with quill or horn terminations, one for the mouth of the physician, the other for the nose of the patient; in an emergency, any sort of an uncollapsible and non-irritating tube may be used for this inflation, as, for instance, an open catheter or

a large syringe. If, after using powerful inflation several times, during which the little patient, with a frightened look, grasps at the ear, he gradually becomes more quiet and natural than before; if the temperature and fever fall, the dulness and irritability diminish, and especially if the sensorium and the hearing, so far as it can be tested, are clearer, there can no longer be a doubt that the middle ear is full of secretion. Luke-warm syringings of the nose act in a similar, but less effectual manner, by washing out the mucus collected in the nasal and retro-nasal cavity, in this way freeing the orifices of the Eustachian tubes.

It is thus seen that even in the most obscure cases there are a number of points which are of value in establishing a differential diagnosis between acute otitis media and meningitis, and if, in fact, as many authors assert, the former is very frequently overlooked or unrecognized, the chief reason is that the existence of "cerebral" symptoms with exudative tympanic inflammation and the frequency of this disease in childhood are not yet sufficiently appreciated by the majority of physicians. Physicians are still too little accustomed to consider the ear as a very frequent seat of disease, even when there is no complaint of pain or discharge, and still less to regard it as one of the organs which, under pathological conditions, may seriously disturb the whole organism. When acute otitis media in children receives the attention which its frequency and importance deserve, it will undoubtedly be earlier recognized, and gradually more positive data for the diagnosis will be established.

It must become the duty of every qualified practioner, in a large number of general diseases, especially with children, to inform himself of the condition and powers of the ear, and also to direct the attention of the attendants to this organ without waiting for urgent symptoms to proclaim themselves. In all violent inflammations of the

nasal and pharyngeal mucous membranes, the frequency of a simultaneous disease of the mucosa of the ear should be borne in mind, especially in scarlet fever and small-pox;[1] in diphtheria and croup, the ear should never be forgotten, as experience shows both that these affections very frequently extend to this organ, and also that the aural inflammations accompanying them often assume an unusually serious and destructive character. A distinguished American physician, Edward H. Clark, Professor of Materia Medica of Harvard University in Boston, said,[2] twenty years ago: "So important is a proper attention to the ears during and after the diseases just referred to (exanthemata), that the physician who treats such cases and neglects to give this attention, cannot be said to perform his duty to his patient."

How is it with us in practice? To be sure in every case of acute exanthema, the pulse and temperature are noted several times a day; the skin, the tongue, and even the pharynx are watched, the urine is tested for albumen and other anomalies, the condition of the bowels and other functions are regularly inquired into; in short, all is examined and watched, and this is praiseworthy and necessary; but if the same regular and thorough investigations were made of the ear and hearing power, if this organ was submitted to tests, inspection, and treatment when necessary, much deafness which later is incurable and many chronic otorrhœas which endanger life would be avoided, and many children would not become deaf-mutes. It must be unconditionally affirmed that, in all those general diseases in which experience has shown that the ear is frequently, or almost always affected, the physician, who will not make himself liable to the charge of dereliction of duty, must note the condition of the ears without waiting

[1] According to Wendt, affections of the ear occur in 98% of small-pox patients.

[2] "Observations on the Causes, Results, and the Treatment of Perforations of the Drum-membrane." American Journal of Medical Sciences, January, 1858.

for the complaints of the patient or the communications of the attendants. By this early attention, much misery and injury will be prevented. Especially does the ear require timely treatment when scarlatina is associated with diphtheria, as then rapid destruction and great deafness often occur, which deprive the child of speech, if it is young, and make it a deaf-mute.

In regard to the course and prognosis of an acute otitis media, the great width of the Eustachian tube in children must be regarded as a very favorable circumstance, as the secretion can more readily flow into the pharynx than in adults, and its retention in the tympanum is more easily prevented. The earlier the tympanum returns to its normal condition, the less likely are pathological changes on the tympanic walls and ossicles, such as thickening, adhesions, etc., which lay the foundation, sooner or later, of a decided and often progressive deafness, to be produced. When a violent suppurative inflammation continues for a long time, it may extend to the brain along the blood-vessels leading from the tympanic mucous membrane to the dura mater; rupture of the delicate membrane closing the oval or round fenestra may also occur from the pressure of the pus, or as the result of ulceration, by which the suppuration extends to the labyrinthine cavities, and, as a result, there is an incurable total deafness at the very least. A rupture of the pus through the drum-membrane must, under certain conditions, be regarded as a favorable circumstance. By such a perforation, in itself, nothing is lost: under favorable conditions, and with some attention to cleanliness of the ear, the discharge will cease, and the opening or tear in the membrane heal. In sick and scrofulous children, or when the pus in the ear is quietly left to decompose, the danger of destruction of the soft parts is imminent, and caries of the petrous bone, or some of the results which eventually produce a fatal termination, and of which we shall have

occasion to speak later, may be produced. In children, instead of, or more frequently with, a perforation of the drum-membrane, inflammatory swelling behind the auricle, where later the mastoid process is found, shows itself followed by a perforation of the temporal bone, and a fistula.

Treatment.—If acute inflammation of the tympanum is recognized in its incipient stage, the application of one or two leeches below or behind the auricle is indicated in strong children, as by this means the hyperæmia in the ear and within the skull is diminished, and the whole process runs a milder and more rapid course; an active action of the bowels is also often indicated. For the severe pain, in addition to the bleeding, the frequent filling of the meatus with warm water or the application of water compresses to the ear for several hours is recommended. Hot poultices are not advisable, for the reasons which have already been given.

In older children, or in the intense forms of the disease, as during scarlet fever with diphtheritis of the nose and pharynx, an early paracentesis of the drum-membrane is, without doubt, the best treatment, as thereby the patient is not only spared much pain, but the early evacuation of the pus may prevent the softening and destructive processes which are liable to occur in the tympanum. With good illumination, the operation is very easy, and can be performed with any long cataract- or corneal paracentesis-needle; if it is to be done on the posterior half of the drum-membrane which lies most exposed, it should be remembered that this portion is sharply inclined, its lower part lying deeper, and consequently farther from the operator than its upper part; consequently, in making an incision from above downwards, the needle should gradually be pressed farther inwards in order that the cut may not be too small. After the operation, the pus should be evacuated as thoroughly as possible by Politzer's inflation,

and then syringed out of the meatus with warm water; if the secretion is very adherent, injections of a one-per-cent salt or soda solution through the catheter till the liquid runs freely from the ear would be still more effectual. By an early and thorough evacuation of the secretion, the formation of pus will, under favorable conditions, soon cease, and the wound close: in any case, the chances for the hearing and for the future of the child are much more favorable after an operation. In other cases, the clearing of the tubes by Politzer's inflation is alone sufficient, or at least of great benefit. When there is a disposition to rupture of the membrane, a very strong inflation may force the air through with a whistle, and in this way, just as by a paracentesis, a thorough evacuation of the secretion may be produced. If the disease is only in one ear, Politzer's inflation is often of little or no value, as, if there is a decided difference in the permeability of the tubes, the compressed air passes, as a rule, to the free ear: the application of the catheter is often subject to local and individual difficulties. Since children, as a rule, vomit easily, it would sometimes be worth while trying whether frequent antiperistaltic movements and the resulting concussion would not force the secretion from the tympanum; sometimes in this way a rupture of the drum-membrane and evacuation of the muco-pus is effected.

With this disease the affection of the nasal and pharyngeal mucous membrane, which often causes or keeps up the ear disease, should always be treated. Above all, the secretion which adheres to the walls and stops up the nostrils should be removed by abundant washing. If syringing into the nose is used, care should be taken that it is done slowly and that the water has a free exit. It is more convenient and thorough to use for this purpose the nasal douche of Theodore Weber or an irrigator, but the reservoir should not be held too high so that the pressure may not be great, and the stream should be frequently inter-

rupted in order that the water may not overcome the closure of the tubes and pass into the ear, either from its own pressure, or from involuntary swallowing.[1] The fluid should always be lukewarm (77°–90° F.) and simple water should never be used, as this causes the epithelium of the mucous membrane to swell; usually a one-per-cent solution of salt or milk and water in equal parts is used. If the mucus is very viscid and apt to form crusts, a solution of soda should be used. In specific diseases, or if decomposition of the secretion in the nose has taken place, disinfection with potassic hypermanganate or with salicylic acid may be used, the latter added to a borax solution. The pharynx should be treated with gargles as soon as they can be used, with spray or by painting with a solution of silver nitrate; with severe inflammations ice should be held in the mouth, ice-water sprayed upon the pharyngeal mucous membrane[2] and applications of ice made about the neck. Such a treatment should not be regarded as too energetic or too powerful, and the timid but, in reality, very inhuman views of parents and aunts who assert that the very sick child should not be so disturbed ought not to be considered; in serious cases let the physician explain with all clearness how the future of the child depends upon a favorable termination of the ear disease, and emphasize the fact that the loss of hearing condemns it to a

[1] As, from inexpert manipulation, the very useful nasal douche is liable to do great mischief, especially in children, I always direct the instrument-maker to furnish simple printed directions with the apparatus. These are given in full in Archiv für Ohrenheilkunde, ix., p. 191: in brief the cautions are:

1. Never use plain water, but, if nothing special is ordered, either a solution of salt or milk and water.

2. Always have the water lukewarm (77°–90° F.)

3. Never have the reservoir higher above the nostrils than 1–1½ feet.

4. Avoid swallowing and breathe quietly through the mouth during the operation, and with children occasionally interrupt the current.

5. Direct the stream directly backwards, never upwards.

[2] The atomizer for the naso-pharynx which is described under the treatment of chronic catarrh is specially useful for this purpose.

life-long deaf-mutism. If the family refuse their consent, the physician has at least done his duty.

Simple Chronic Inflammation of the Middle Ear or (non-purulent) Chronic Aural Catarrh.

In describing acute aural catarrh, we have, for practical reasons, thought it better to consider the various forms and degrees under which the inflammatory process in the middle ear shows itself in one description. A similar arrangement cannot, however, be carried out in chronic catarh, and we must separate the subject into two divisions; the cause of the disease, its significance, its results upon the ear and the individual, but more especially the therapeutic principles to be adopted, vary very much according as the secretion is epithelial and mucous with a tendency to thickening of the tissues or purulent with, usually, a destructive character.

We will first describe the simple or non-purulent form of chronic catarrh. This is developed in children more frequently than in adults from a preceding acute inflammation, and is therefore to be regarded very often as the residuum or result of such an inflammation. Although the attendants often may know nothing of such an acute attack at the beginning of the trouble, such has frequently existed without being observed or properly recognized. We have already shown how easily an acute secretion in the tympanum may be overlooked, even when it occurs in later childhood, if the disease is unilateral and unaccompanied by severe pain localized in the ear; the proper recognition of this condition is naturally still more difficult in very small children. In other cases the pathological process in the ear depends upon causes which are slow and gradual in their action, and the ear disease then has from the beginning an insidious character.

In both varieties, that coming on after an acute inflammation and that beginning insidiously, abnormal condi-

tions in the nose and pharynx, such as are seen daily in children, play an essential rôle. All the surroundings in childhood, however, favor the extension of pathological processes in the mucous tract of the head to the ear, as has already been minutely described. The unusual ease with which the pharyngeal orifices of the tubes become closed in children should be again emphasized. In adults even the tissue of the mucous membrane between the two ostia pharyngea tubarum is very rich in glandular elements of various kinds, but in childhood these elements, especially those corresponding with the lymph-glands and lymph-corpuscles, are still more decidedly developed. In early life, the cavum naso-pharyngeale is so very narrow that the tubal orifices are easily compressed and mechanically closed by the surrounding mucous membrane and its glands. In adults, the orifices of the tubes stand wide open like a trumpet, and the posterior cartilaginous lip is distinctly marked as a prominence; but in children these orifices are mere lineal slits without distinct lips, so that in the body of a young child they must be sought for among the various depressions and fissures of the swollen mucosa naso-pharyngealis.[1] In the cartilaginous tube of the child the mucous membrane is particularly thick and unusually rich in folds while the cartilage itself is relatively much less developed than the membranous part; in adults the membranous portion which forms the anterior portion of the tube, constitutes the smaller half of the circumference, while in the new-born child it constitutes by far the larger half.

It is evident that, with these anatomical relations as they exist in childhood, a permanent cohesion of the mucous surfaces may easily take place, not only at the orifices, but also along the course of the Eustachian tubes; and consequently in childhood closure of the canal, both from its fre-

[1] Compare the description of the child's naso pharynx on page 32.

quency and its obstinacy, plays a much more important part than it does in adults.

As we have already seen, long-continued closure of the tube, by producing rarefaction of the air in the middle ear, causes an enormous swelling and succulence of the mucous membrane, with an increased transudation of serum into the tympanic cavity, so that a normal condition of the tympanum with a chronic disease of the tube is impossible. A primary or idiopathic catarrh may also develop in the tympanum, either from disease of the blood-vessels or from disturbances in the nutrition of the mucous membrane; in such a case the congestive swelling of the mucosa at the tympanic orific of the tube, or the collection of secretion at this point produces obstruction, so that under certain conditions a closure may be developed without any disease of the naso-pharyngeal mucous membrane. It is thus evident how greatly pathological states of the lower and upper portions of the middle ear may mutually act upon each other, either in producing disease or in increasing the pathological condition.

In addition to the independent diseases in the tympanic tissues and the disturbances of nutrition in the nasal and pharyngeal mucous membrane, to which these parts are specially predisposed during childhood and school-life, from the injurious influences to which they are exposed, the condition of the blood-vessels plays an important part in the pathogenesis of chronic aural catarrh. Chronic hyperæmias and stases in the neighboring vessels, but especially extended disturbances of the circulation, must necessarily exert an influence on the amount of blood in the pharyngeal and tympanic mucous membrane, particularly upon the region supplied by the arteria meningea media which is in direct relation with the ear; further it should not be forgotten that mechanical hyperæmia in every mucous membrane produces catarrh, and wherever the vessels of the mucosa for any reason are overfilled with blood, not

only great swelling and succulence of the tissue, but an increased formation of young cells and abnormal secretion is produced. A greater blood-pressure from increased action of the heart in fever or any increased tension of the arterial system, as in Bright's disease, must necessarily produce a certain hyperæmia even in the mucous membranes of the head. On the other hand, venous hyperæmia in the head is often produced by the pressure of tumors in the neck, originating in the lymph-glands or the thyroid. Similar congestive or œdematous conditions are often produced by passive congestion in the vena cava superior, by mitral insufficiency, by emphysema, and by other diseases of the lungs which interfere with the circulation, especially pleuritic exudation; they are also caused by abnormal elevation of the diaphragm, the result of collections of fæces, of ascites, tumors in the diaphragm, etc. It is well established that in the upper pharyngeal cavity above the palate, there may be developed—as the result of laxity in the cystogenous tissue or of insufficiency of the muscles of the walls, the contraction of which assists the movement of the blood, or in consequence of the horizontal position of the upper wall of the pharynx in reference to the pharyngeal tonsils—such secondary conditions in the blood-vessels as favor œdema or hyperæmia, much more regularly and in a greater degree than in the lower portion of the pharynx. As usually, during life, only the lower or oral pharynx is inspected, and as the naso-pharynx is only very rarely examined post-mortem, the abnormal conditions of this cavity, which are of fundamental importance for the ear and for the health, generally escape the observation of physicians and pathological anatomists.

Let us notice here some of the peculiar conditions of this cavity. It is possible that the bleeding from the nose, which occurs so often in childhood, arises not infrequently from the vessels of the posterior part of the nasal cavity where the end of the lower cartilage and the choanæ have

a peculiar erectile tissue like that in the penis. The frequency of hæmorrhages in the tissue of the naso-pharynx, and particularly in the pharyngeal tonsils, is shown by the not uncommon appearance of reddish-brown or slate-colored pigmentation; bloody sputa arise much oftener from these upper regions than is usually supposed. As the most common result of a chronic catarrh of these parts we see an enlargement of the glands with a distention of their ducts and an abundant secretion; in very marked cases of the disease, the mucosa, when freed from mucus, has a cribriform or sponge-like surface, which may appear knobbed from hypertrophy of the follicles, from cysts or from enlarged acinous glands. Not infrequently, from the closure of a gland, its cavity becomes enlarged, forming a true cyst, the contents of which may be pure mucus, colloid material, or composed of fatty or chocolate-colored detritus.

The changes which the mucous membrane of the cavum pharyngo-nasale undergoes from hyperplastic catarrh, and which is recognized by an increase in its volume and a total change in its surface, are worthy of special study. In this disease there are developed, in great numbers, ridge-like, conical, knobbed, or lobular prominences, and these are often so numerous that the air-cavity and the permeability of the pars nasalis pharyngis in breathing and speaking is either destroyed or seriously interfered with, and this the more from the fact that these polypoid formations are usually covered with an abundant and adhesive mucus: they occur most frequently on the centre of the pharyngeal arch, but are also found on the pharyngeal tonsils, on the lateral walls, and in the neighborhood of the tubal orifices.[1] These hypertrophies of the mucous

[1] These hyperplastic new growths of the naso-pharynx were first described by Wilhelm Meyer, of Copenhagen, under the name "adenoid vegetations" (Hospital Tidende, November, 1868, Archiv für Ohrenheilkunde, vii. and viii., with illustrations). The most thorough account of all the pathological processes of

membrane are to be distinguished by their red color and firmer consistency from the less common true nasal polypi which appear gray or grayish-blue with vessels on their surfaces. Although these hypertrophic formations are developed more frequently and largely in northern and sea climates, still they are often found in children and young persons living in other climates when the pharynx is regularly submitted to digital examination. The percentage of such cases would be more evident if it was customary at autopsies to submit the naso-pharynx to examination either by inspection or by palpation with the finger.

The course of chronic aural catarrh and its symptoms are, of course, multiform, as would be expected from the frequency of the affection, and from the very variable causes from which it arises. In children, where there is a great tendency in this disease to cause permanent closure of the tube, with secretion in the tympanum, pain in the ear is very much more common than it is in adults. This comes on with great severity in the depth of the ear, but unaccompanied by swelling or tenderness of the external parts, and continues usually for a few hours or, at most, for a night. Sometimes mothers report that, after such an attack of pain, a light-colored or bright-red spot is found on the pillow, or a small quantity of watery fluid is seen at the entrance of the meatus. If such a case is examined immediately, the epidermis of the drum-membrane is seen to be loosened, usually on the posterior and upper quadrant, and sometimes a red streak is seen upon it; sometimes also a serous-bloody fluid or a mass of mucus is found in the deeper part of the meatus. In some children, who have often suffered from such rapidly-passing attacks of pain, a deposit of bright-yellow flakes of loose consistency is seen at the posterior and upper end of the meatus, due to a slight secretion from the tym-

the naso-pharynx will be found in Wendt's article in Ziemssen's Cyclopedia, where on page 267 a synopsis of the literature is given.

panum, which has partially dried, become mixed with flakes of epidermis from the drum-membrane, and then been pushed backwards and upwards toward the periphery. In other cases, voluntary rupture of the membrana tympani does not take place, but there is found on the posterior half of the membrane a yellowish-gray or reddish vesicular projection filled with fluid, which sometimes projects forward over the manubrium, sometimes hangs downwards, and which can usually be punctured without any pain. The pain in the ear with chronic catarrh not infrequently, however, ceases without any secretion being recognized in either of these ways, as it is discharged downwards through the tube, or is rapidly absorbed; while, in still other cases, the pain is an expression of irritation of the sensory nerves, produced merely by the hyperæmia and swelling of the tissue without much secretion.

During a chronic aural catarrh, with the pain, or instead of it, such a subacute fluxion as we have described with acute aural catarrh may produce extensive nervous irritation, and symptoms of pressure in moderate degree, and, as we have already seen, be overlooked, not only in small children, but even in older persons; or else it may be referred to some other trouble.

The possibility and even probability that a certain amount of disturbance in the sensory system escapes proper recognition is shown from the fact that not infrequently children with chronic catarrh are brought to the physician without any history of pain or similar symptoms, the disturbance of the functions of the ear, i. e., diminished power of hearing, alone pointing to a disease of that organ. Such cases are those in which the beginning of the trouble cannot, as a rule, be accurately determined even by years, as the attention of parents and teachers was first attracted by the very great loss of hearing; the preceding, less marked deafness having been unnoticed, and

even for a time having been misinterpreted, till finally it has dawned upon them that the child hears badly or scarcely at all. One must have often seen it to appreciate how frequently, in educated families, and under the observation of otherwise competent physicians, dulness of hearing in older children, and even total deafness in younger ones, has remained for a long time unrecognized and unobserved.

It is true that the beginning, as well as the progress in speaking, is very variable in children with normal hearing, even in the same family, and this may be one reason for overlooking early deafness. But, when children have reached the age of one to one and a half years, and utter no sounds such as ma-ma or pa-pa, and do not even begin to affix words or sounds to the things with which they are daily surrounded, accurate observations should be instituted to learn in how far the power of hearing exists. This is still more important and necessary when older children make slow progress in the formation of letters, and in the proper pronunciation and accentuation of words, or when they gradually speak less distinctly and lispingly.

On the other hand, injustice is done to many older children at home and in the school, when they are scolded or punished for "absence of mind," "inattention," or for always demanding a repetition, as it only too frequently happens that they really do not understand, owing to deficient power of hearing. If these symptoms are noticed often and for a long time in an increasing degree, attempts should be made to decide fully whether the child in reality does not take the trouble to understand what is said, or finds it more convenient not to hear what is commanded, or whether the hearing actually is unequal to the demands made upon it; this decision can be reached by not repeating what has been said, or better still, by comparing the hearing of the child for the watch, and for speech, with the hearing of a normal person. The re-

peated application of such an objective test is the more necessary, as several complications may exist. In children with chronic catarrh, there may exist, under the influence of varying conditions of the mucous membrane, a very great difference in the degree of hearing, so that the child which is extremely deaf, on rising in the morning, may later hear perfectly well, or the one which, on a dry day, hears the teacher from the further side of the room, may, in damp weather, or during a cold in the head, be obliged to sit very near, in order to follow the instruction. It is not unnatural that children who understand little or nothing at home or at school without special exertion, and to whom the following of conversation causes extra fatigue, should early relax their attention, and from weariness no longer exert themselves, but rather prefer to indulge in their own thoughts, when, if the hearing was good, they would be in a position to understand the teacher, and what was going on around them. This "absence of mind" and disagreeable "what say" of children is due very often to a changeable hearing, and not alone to a permanent deafness. In order not to be misled, it is necessary, under such conditions, to test the hearing a number of times, and to examine the condition of the nasal and pharyngeal mucous membrane.

The deafness with chronic catarrh not only varies at different times in some cases, but is also of different degrees of intensity and importance. It should be particularly mentioned that a very great loss of hearing may be produced by pathological processes in the tympanum, that is, by a diminution in the vibratory power of the ossicles, and in the transmissibility of the sound-waves through the labyrinthine fenestræ, so that, for instance, loudly spoken words are only understood when close to the ear, and a common watch of six feet normal hearing-distance is heard neither upon the ear nor by bone-conduction, and a repeating watch, which is normally heard at the length

of several rooms, is only distinguished a few inches from the ear. A repeating watch without a case or some similar set of works, is best adapted for testing the hearing in children, not only on account of the intensity of its tone, but because the ticking can be readily interrupted during the examination, without the motion for so doing being seen, and it is thus possible to decide upon the trustworthiness and truth of the patient's statements, in a way which cannot be done when a common watch is used. The majority of young children will nod with the head when a watch is laid upon the ear, whether they hear it or not, and for establishing the fact with certainty, if the child has the patience, it should be made to signify with the finger each stroke of the works which it hears, or, if it is old enough to count, should give the number of the tones heard.

The test with the speech is of greater importance in deaf children; for this purpose, words—the best are numerals or names of several syllables—are spoken at one ear, while the other is firmly closed by some person. According to the distance at which loud, moderately loud, or whispered words and sentences can be properly repeated by the patient without looking at the lips of the speaker, can the degree of deafness for speech be estimated, and the effects of treatment be learned. Of course, different words will be understood more or less easily, and at a greater or less distance, according to the sounds with which they begin, and the open or closed vocals which they contain. The mouth of the speaker should be at the same height as the meatus of the patient. In repeating tests for comparison, the very greatest care must be taken that all the surroundings are always the same. In very great deafness, such as is more common, however, with other diseases than those we are here considering, a conversation-tube should be used, into which words, or in extreme cases, vowels should be spoken, and repeated by the patient.

When the perception for external sound-waves is very much diminished from defective mobility of the tympanic apparatus, as, for instance, when the speech of others is only understood in close proximity, the voice of the patient himself must be less clearly and distinctly heard, entirely aside from any confusion or resonance with which the tones are accompanied when fluid exists in the tympanum. In case of great deafness, an adult loses the control over his own voice, and cannot usually tell whether he is whispering so lightly as not to be understood, or is shouting loudly, and, in addition, the pronunciation of certain consonants is imperfect. The effect of imperfect hearing is naturally much more marked in the pronunciaciation of small children who have only used speech for a short time, or have just begun to learn to talk. From imperfectly hearing the speech of others, and from an insufficient or wrong perception of their own voices, there is, in some cases, a decided slowness in the development of speech, in others a very imperfect enunciation, both being conditions which border on true deaf-mutism. We shall later have occasion to speak of this condition, but desire here to emphasize the fact that, in early life, very great changes may be produced in the tympanum by chronic catarrh, and these may be of the greatest importance in the development of the speech and the whole future intellectual growth of the child.

In this latter connection, it is proper here to call attention to a fact which is too little noticed by physicians and parents, namely, the influence which a deafness acquired in early childhood exerts upon the whole future mode of thought, behavior, and being. If we are in everything which we think and do chiefly the product of circumstances that imperiously govern us, and from whose rule, much more than from our independent self-will, it depends how we bear ourselves bodily and intellectually, the surroundings of early life, as the foundation for the future,

must be regarded as of special importance. In childhood, the foundation for the development of our intellectual being depends largely upon the acuteness of our senses, especially of the eye and ear. The senses are the mediators between the brain of the child and the outside world, by means of which he gradually appreciates all details. The impressions conveyed to the child's brain through the eye and ear excite thought, imagination, and expression. The fundamental importance of the organs of sense for the intellectual development of the child would be denied by no one, and it is evident that the development of our ability for thought and expression depends upon the acuteness and perfection of these organs in childhood. The more certainly and accurately the senses of a child convey impressions from without, the more clearly will the perceptions be in the brain, and the more sharply defined will be the understanding and application of these external impressions for the formation of ideas and expressions. On the other hand, if the child sees imperfectly, if he hears only a part of what is addressed to him, from these imperfect, indefinite, and often inapplicable impressions of the senses are produced only confused ideas, wanting both in clear definition and perfect form. In this way, thought fails of its proper clearness, and the whole intellectual being and the character bear the stamp of imperfection and mistiness.

Who would venture to deny that the greater part of the education, both at home and at school, is transmitted to the child through the ear, not only so long as it is unable to read, but even later than this? Every teacher will allow that deaf children are particularly prone to become fickle or visionary; that it is especially difficult for them to give continuous attention during instruction or conversation; that, as a rule, it is hard to get them to concentrate their thoughts. On the other hand, we cannot wonder that, in such children, unless nature and edu-

cation have been particularly adapted to correct the disadvantages of early deafness, are produced imperfect and unpractical characters, often decidedly illogical in thought, superabundant in speech, vacillating and uncertain in business; in short, their whole being has a character peculiar to itself. An observing physician is often able to make a probable diagnosis from the behavior of a patient, from his desultory answers to questions, and from his circumlocution, that the deafness is by no means, as he himself asserts, of recent origin, but already existed in a marked degree in early childhood.

After this discussion of the results of deafness in the child, which will hardly be considered by the thoughtful physician as an unnecessary digression, let us return to a description of the other symptoms of chronic catarrh. As has been already said, in children a great variation in the hearing and in the other symptoms is noticeable. This depends in a great measure upon the existing degree of congestion and volume of the naso-pharyngeal mucous membrane, and upon the accidental closure of the Eustachian tubes. Such patients always hear worse with great moistness of the atmosphere, from a chill following overheating, with or after a cold in the head, or an angina, also in the morning on waking up, and during meals—not alone during the act of chewing, which always diminishes the hearing for external noises—and especially when the nose is stopped up. We have already described, under the name of the Toynbee experiment, the act of swallowing with the nostrils closed, which rarefies the air in the tympanum, and produces the same results as closure of the tube. What the fingers do by closing the nostrils in the physiological experiment is accomplished in the catarrhal child by the swelling of the mucous membrane and the collection of mucus in the nasal cavity. Such a child, during the act of eating, is performing continuously Toyn-

bee's experiment,[1] and, by the introduction of large quantities of warm food, such as soup or vegetables, the temperature in the pharynx and neighboring parts is raised, and there is a temporary increase in the amount of blood, water, and secretion of these parts.

A diminution of the pneumatic cavities of the nose and upper pharynx in children often makes itself evident in other very marked ways: in the expression of the face and in the articulation. If the natural passage for in- and exspiration through the nose is not sufficiently open, it is necessary that the lips should be separated and the lower jaw drawn down in order that the air may be received and expired through the mouth. This breathing through the lower pharynx occurs in every person as soon as the nose is accidentally closed, or an increased activity in breathing is necessary, as in running or in climbing mountains. A child is obliged to adopt this mouth-breathing much oftener than adults, on account of its narrow nasal cavity and the rapidity of its respirations. In addition to this, the naso-pharynx is frequently closed by mucus, by thickening of the mucosa, or by enlarged tonsils; so that in childhood absolute nose-breathing is rare and accessory, while, on the contrary, absolute mouth-breathing is very common. As the result of the hanging jaw and open lips, the countenance often assumes a simple, vacant, and fixed appearance, destitute of expression; so that such patients are often considered stupid and weak-minded. The inactivity of the nose in respiration is often associated with a marked sinking of the nasal alæ and laborious breathing, with a raising of the eyelids and eyebrows, and often, also, of the skin of the forehead. How much the countenance of such patients improves in appearance, in the life and expression of the angles of the mouth and

[1] A. Lucae, "Neuer Zusammenhang zwischen Nasen- und Ohrenkrankheiten." Archiv f. Ohrenheilkunde, iv., 1869, p. 188.

nose, and in its general quiet, when a perfect nose-breathing has been established by appropriate medication, is best shown by photographs before and after treatment.[1]

Still more serious is the influence which habitual impassability of the nose produces upon the sound of the voice and upon the formation of tones. In some cases, the voice is destitute of its proper fulness and resonance from a diminution of the normal air-cavity. All the tones sound flat and short. In other cases, the nasal tones m, n, and ng are pronounced imperfectly or not at all. For their production, as is well known, the air must pass freely through the nose; while, for the intonation of all the other letters, the palate closes the upper from the lower pharynx. When the tonsils are abnormally large, so that the free movement of the palate is interfered with, the voice sounds as though the patient had the mouth full of something. Very frequently the pronunciation of the nasals is difficult from this condition alone, entirely aside from the fact that there usually exists a chronic naso-pharyngeal catarrh, with a secretion of mucus upon the posterior surface of the soft palate.

It should be said here that blowing the nose, which is intended to cleanse and render free that organ, is of no value when the nostrils and upper pharynx are stopped up. When it is difficult to teach children to perform this operation, which, under certain conditions, is so desirable, the fault is very often to be attributed to the swelling and closure of the nasal cavity. After washing out the nose with fluid, or after inserting deeply into it a feather dipped in oil, which is often followed by sneezing, blowing of the nose can often be better accomplished, especially if, after peasant fashion, it is undertaken while closing one nostril with the finger, without any use of the handkerchief. In

[1] Meyer gives five such illustrations in the Archiv für Ohrenheilkunde, Vol. viii., 1874.

this way the expressed air, when the mouth is closed, is driven forcibly behind the palate, and any movable impediments are carried towards the anterior nostrils, and gradually expelled. Frequent insufflations of air into the nostrils by means of a rubber bag (the dry nasal douche of Lucae[1]) are in such cases of very great value. Naturally, the greater the swelling and hyperplasia of the mucosa which cause the impermeability the more difficult is it to force air through the nostrils, either from in front or from behind, and the less likely is it that the child can effectually blow the nose itself. Asthmatic conditions and the screaming of children at night are not infrequently due to a deficient permeability of the nose, and the snuffles in nursing infants must be regarded as endangering the life, on account of its injurious influence upon the sleep and the reception of nourishment.[2]

Returning now to the peculiar aural symptoms of chronic catarrh, the subjective aural sensations should be mentioned which, in adults, pass under various names, as roaring, ringing, etc., and constitute a very common and highly irritating sensation. In children, also, tinnitus is not infrequently produced by chronic diseases of the middle ear, but it is almost always necessary to inquire directly for it, in order to learn of its existence. When this is done, many children will, after a moment's thought, assert that they often hear, especially at night, a sound like the wind, or like whistling, which other persons are unable to catch. In subacute cases, they often speak of a knocking or hammering in the ear. It is very possible

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[1] Berliner Klin. Wochenschrift, 1876, No. 11. According to Lucae, simultaneously with the use of the instrument, a, æ, o, or err should be intoned, to accomplish which a little ingenuity is necessary with little children.

[2] S. Kussmaul: "Ueber den Schnupfen der Säuglinge." Zeitschr. für ration. Medizin, 1865, p. 225. Gerhardt's Lehrb. der Kinderkrankheiten. 3. Aufl. Tübingen, 1874, p. 278, and author's Lehrbuch der Ohrenheilkunde. 6. Aufl. Leipz., 1877, p. 328.

that chronic aural catarrh in children frequently runs its course without subjective noises, as we know that in adults this symptom increases in frequency and in its irritating character with an increase in age: at any rate, with children it does not produce marked annoyance or complaint.

What appreciable changes in the affected organs does the examination of a child suffering from aural catarrh show us? The meatus, as it does not take part in the pathological process, is normal, except, as already described, where the secretion has ruptured through the drum-membrane and is found lying in the deeper part of the passage, either as a moist liquid or as dry scales, often intermixed with epidermal flakes. In such cases, syringing with warm water is necessary to get a complete view of the drum-membrane. This membrane, just before rupture takes place, shows a loosening of its epidermal layer, which produces a perfectly opaque and whitish-gray appearance, as has been already described; just after the rupture, the fresh wound is distinctly visible in the form of a reddish streak. After attacks of pain, spots of extravasation can often be seen on the surface of the drum-membrane without our being able to recognize any fluid in the ear or upon the pillow. Such cases are seen much more frequently by the observing family physician than by the aural surgeon; but it may be said to be the general rule with chronic tympanic catarrh, that the epidermal layer of the drum-membrane easily becomes opaque and loses its reflex. The outer surface of the membrane is not otherwise altered, except that some of the blood-vessels which run along the manubrium or radiate towards the periphery become visible. This radiating injection occurs when there is a large collection of secretion in the tympanum, and is most easily recognized when sunlight or other powerful illumination is thrown into the depth of the meatus from a plane mirror. Such a secretion also

makes itself apparent sometimes by very marked changes upon the surface of the drum-membrane, when grayish or yellowish vesicles or hernial sacs appear, especially upon the posterior half of the membrane. In children, such appearances are quite common after subacute and also in the course of chronic catarrhs.

The appearances that have been described naturally furnish the diagnosis of the process which is taking place in the tympanum and of its exudative character. Unfortunately, the diagnosis cannot, in many cases, be found so simply written upon the drum-membrane. In children, the membrane, even when the tympanum is filled with fluid secretion, is much less commonly bulged outwards in some of its parts; more frequently with this condition it is tensely drawn inwards throughout its whole surface. The funnel-shaped concavity of the membrane is then much increased, and the processus brevis mallei is unusually prominent, appearing as a white knob, and the manubrium, which normally shows as a whitish line running downwards from the short process, now appears more oblique, foreshortened, and smaller, owing to the drawing inwards of the whole membrane. When the membrane is extremely drawn in, the oblique position of the manubrium is made out with difficulty. The anterior and posterior folds, which run from the short process of the hammer, now appear more distinct than normal.

We have already called attention to the fact that, in a child, up to a certain age, the drum-membrane is thicker and less transparent from the development of its surface-layers; add to this, as occurs in catarrhal processes, the succulence and swelling of the tympanic mucous membrane which covers the inner surface of the membrane and the grayish appearance and lack of translucency are increased, and, again, are made still more marked by the drawing inwards of the membrane, produced by the closure of the Eustachian tube and by the secretion which

lies behind it. As, in the normal condition, the mucous covering of the drum-membrane is thickest on the periphery, the hypertrophy of this tissue produced by catarrh will be most marked at that portion of the membrane. At this same spot there frequently remains, when the mucous membrane returns to its normal condition, a thickening, which shows as a whitish-gray peripheral ring, often with sharply-defined edges upon its inner side. This coloring and thickening on the periphery, which is the result of some previous disease, shows most distinctly when, from any accidental closure of the Eustachian tube, the drum-membrane is forced inwards, for the thin central portion of the membrane yields much more readily than the thickened and resistant peripheral portion, and the funnel-shaped central part of the membrane then appears reddish and thin, surrounded by a whitish-gray rim which retains nearly its old position and consequently forms quite a sharp angle with the central depressed portion.

In addition, there are produced during the course of catarrhal processes various changes and irregularities in the color and the surface of the drum-membrane. Sometimes certain spots become opaque, or otherwise discolored from circumscribed thickenings of the tissues, or from the deposition of molecules of lime or of fat; sometimes circumscribed or extended depressions are formed as the result of abnormal adhesions between the inner surface of the membrane and the ossicles or the tympanic wall; sometimes thin and atrophied spots are seen upon the membrane, usually referable to the healing of perforations or long-continued adhesions which have gradually relaxed or separated entirely. As such thin spots offer but slight resistance to the pressure of the external air, they usually sink inwards and approach the parts within the tympanum which, therefore, become more distinctly visible than usual. The abnormal appearances which result from chronic

tympanic processes are extremely numerous and of infinite variety. The appearances upon the drum-membrane are not always easily interpreted, and the pathological processes within the tympanum and upon the inner surface of the drum-membrane can only be partially recognized by inspection of the latter membrane. The dissections of diseased ears,[1] which have been described in large numbers, show most conclusively how variable and extended are the changes which catarrhal processes produce in the tympanum.

Pathological changes behind the drum-membrane are not always recognizable from the abnormal appearances seen on the membrane itself. Visible abnormities upon the membrane do not, by any means, always correspond with the extent of the pathological processes within the tympanum and with the degree of deafness. This latter, on the contrary, depends on the disturbances which the conducting apparatus, the ossicles and the labyrinthine fenestræ, have suffered, and these changes we are not able to recognize directly, but can only diagnosticate from probabilities. If, in the case of a marked degree of deafness, the history of the disease, the condition of the nose and pharynx, and especially the appearances on the drum-membrane before and after the air-douche point to a catarrhal process, while there are no symptoms of a labyrinthine trouble present, we must assume that we are dealing with

[1] On the pathological anatomy of tympanic catarrh, see "A descriptive catalogue of preparations illustrative of the diseases of the ear in the museum of J. Toynbee." London, 1857. Author's "Anatomische Beiträge zur Ohrenheilkunde," in Virchow's Archiv, xvii. (1859), p. 1–80; and in Arch. für Ohrenheilk., vi. (1871), p. 45–76. Politzer's "Beleuchtungsbilder des Trommelfells im gesunden und kranken Zustande." Mit 2 Tafeln Abbildungen. Wien, 1865. Translation by Mathewson and Newton, l. c. Gruber's "Lehrbuch der Ohrenheilkunde." Mit 2 Tafeln Trommelfell-Bildern. Wien, 1870. Wendt, Archiv f. Ohrenheilk., vi., p. 295, und Wagner's Archiv für Heilkunde, xi.–xv. (1870–74). Schwartze's Patholog. Anatomie des Ohres. Berlin, 1878. Translation by Green, l. c.

changes which seriously interfere with the functions of the tympanic apparatus and with the transmission of vibrations from the drum-membrane to the labyrinth. Whether this interference occurs as the result of the tympanum being filled with viscid mucus or from a thickening of the mucous membrane covering the ossicles and their articulations, thus increasing their weight and restricting their mobility, or from the fact that the stapes is bound down and made immovable by a growth from the mucous membrane filling the pelvis ovalis, or by a thickening of the membrane surrounding its base, can frequently only be determined by long observation, and by watching the action of local therapeutics, when we can decide with probability or with certainty on the existence of one or the other condition. In the beginning of many cases in adults, and often in children, we meet with great difficulties in making a precise diagnosis, so that often, at first, we must content ourselves with the general diagnosis of a catarrhal process in the middle ear.

For the purposes of diagnosis, the air-douche is, as a rule, the most useful as it often alters the appearances of the drum-membrane and the hearing that the catarrhal nature of the process becomes more decided. After inflation, the membrane should always be again inspected, for, if the air has entered properly, it is forced outwards, as can be best seen by examining its upper posterior periphery; in this way collections of fluid behind the membrane, variations in its color and thickness, depressions and contractions due to partial atrophies and adhesions, etc., will be much more distinctly marked after inflation than they were before. The hearing distance for the voice and the watch should also be tested, so far as is possible in the special case, after the air-douche. The more readily the abnormal condition is removable by mechanical means, the more decided will be the improvement after the inflation.

In little children, the catheter can rarely be used, and we must be satisfied with inflation into the nose by means of the air-bag. The disadvantage of Politzer's inflation is that we cannot with certainty select the ear in which we desire the compressed air to act, as it will either entirely or chiefly pass into that ear which offers the least resistance to the current. The smallness of the air-cavity in young children renders it possible for the air to enter both ears much more easily in them than in adults. If we are dealing with patients upon whom the catheter can be used, auscultation of the ear can be practised, which teaches us whether and how the air enters. To do this, the ear of the patient is connected with that of the surgeon by a rubber tube (diagnostic tube), and air is forced into the catheter from the air-bag or from the mouth. To speak of the methods of catheterizing and the necessary instruments, would be here out of place, as no one would pretend to catheterize a child who was not perfectly familiar with the operation by practice on adults. Aside from the narrowness of the nasal cavity, due to the smallness of the skull and the great thickness of the mucous membrane, in the child the ostium pharyngeum tubæ lacks the well-developed cartilaginous lip, is a simple slit, and lies lower than in adults;[1] it is, therefore, more difficult to find with the point of the catheter, and, when so found, the instrument can never be turned outwards and upwards, but points horizontally, or even somewhat downwards. It may be remarked here that, with a quiet patient, the catheter is useful as a sound for feeling of the mucous membrane and for judging of the size of the naso-pharynx.

[1] According to the observations of Kunkel "On the changes in position of the pharyngeal orifices of the tubes during development" (Hasse's Anatomische Studien, N. 5, Leipzig, 1869), these orifices lie in the fœtus below the plane of the hard palate; in the new-born they lie on the same plane, while in a four-year-old child they are 3–4 mm., and in the adult about 10 mm. above this plane. The tubes attached to the base of the skull follow the growth of the bones.

It is absolutely necessary for recognizing the nature of a given case to examine thoroughly the condition of the pharynx in both its upper and lower divisions, and also the nasal cavity. With the spatula or finger the tongue is first depressed, and thus the condition of the tonsils, the mucous membrane, and the posterior wall of the pharynx can be inspected. In the case of very small or intractable children, the opening of the mouth can be enforced by closing the nose. If the child can be persuaded to sound a loud "a," a better view can be obtained from the raising of the palate which is thus produced. It should especially be noted whether behind the insertion of the palate, on one or both sides, there is a reddish or œdematous longitudinal swelling to be seen; such is not infrequently present even when all the rest of the mucous membrane, which is visible, appears perfectly normal. These swellings, which are generally symmetrical, show the condition of the mucous membrane at the orifices of the tubes; except in this respect, the appearances of the lower pharynx furnish us with no evidence of the condition of the more important upper pharynx (the naso-pharyngeal cavity). The mucous membrane of this upper cavity has an altogether different structure from that of the oral pharynx, and on this account it is, in children, more frequently diseased.

The inspection of the naso-pharynx by rhinoscopy is only possible in exceptional cases in children under ten years of age, but a tactile examination with the finger is readily made, even by those whose fingers are short. The head of the patient should be supported from behind with one hand, while the forefinger of the other hand is passed backwards into the open mouth; if the palate is drawn up, and the entrance to the naso-pharynx thus closed, wait quietly, avoiding any pressure with the finger. As soon as the patient takes a deep breath, the velum palatinum will sink, and it is then possible to pass the finger upwards, where, with careful movements, it is possible to feel of all

parts of the naso-pharyngeal cavity, on the sides, forwards, backwards and upwards, and in some cases it is even possible to pass the finger through the choanæ into the nasal cavity. With some practice it is possible quickly, and with the finger alone, to gain a sufficiently good idea of the size of these cavities, of the thickness and condition of the mucosa, upon which, as we have already shown, there are often extensive infiltrations or partial hypertrophies, which can be felt as ragged or knobbed prominences. When such exist upon the vault of the pharynx, they usually arise from the third tonsil, tonsilla pharyngea, which is situated at this spot, and, in childhood, is very large and always provided with fissures and irregularities. The finger on being withdrawn is very often bloody, even after a quiet and undisturbed examination, a proof of the succulence and congestion of the tissues; if soft granulations are present in any numbers, nose-bleeding is often produced. The more quietly the patient breathes during this palpation, the more easily and thoroughly it can be made. It is rarely painful, and intelligent children usually allow the later examinations without opposition, although the first may be opposed. Care should be taken, not only to fix the head firmly, but the hands should also be held fast, which can be most easily done by having the child sit in the lap of an adult, who can embrace it with both arms. If the patient does not willingly open his mouth, the nose should be tightly closed. The teeth of the patient are much less likely to injure the finger of the examiner than would be supposed, but it is sometimes advisable to protect the first phalanx with a bit of rubber-tubing, and it is desirable also to take a position beyond the reach of the patient's feet, the reflex movements of which sometimes produce disagreeable blows.

The position of the mouth, and the speech of the child, often give us direct evidence of the permeability of the nasal cavity, and inquiries should be made whether the

child usually sleeps with the mouth open, or whether it frequently snores. In order to learn how permeable the nostrils are at the moment, let the child breathe lightly and then forcibly, with closed mouth, through both nostrils, and then through each separately. Not infrequently it is necessary, in order to learn the condition of the nose and naso-pharynx, to make use of anterior inspection by illuminating the cavity through a speculum or dilator in the nostrils.

In simple cases, the common ear-speculum is sufficient for this purpose, but where it is desirable to inspect the posterior part of the nose from in front, Zaufal's nasal specula[1] should be tried. In early life, the lower nasal passage is disproportionally narrow. Sun-light reflected from a plane mirror is the best for this examination, but often a sufficiently good light can be obtained with daylight from a concave mirror.

Having considered the objective and subjective symptoms of chronic aural catarrh, we can now consider the prognosis, and, above all else, it should be borne in mind that this simpler form of inflammation, in contradistinction to the higher inflammation, which is associated with the formation of pus, shows no tendency to destruction of tissue, but, on the contrary, leads very often to hyperplasia and to permanent thickening of the tissues. If perforation of the drum-membrane, with an evacuation of the secretion from the tympanum, occurs with a chronic simple catarrh, an accident which is much more common in children than in adults, the edges of the rupture lie in contact, and in a very short time heal if no special disturbing influences are present. Such disturbances as interfere with

[1] See Zaufal's very thorough descriptions in Archiv für Ohrenheilkunde, ix. and x., and Correspondenzblatt des Prager ärztlichen Vereins, 1875, Nos. 23 and 24. Nasal dilators, such as are figured in the author's Handbuch, p. 317, are rarely applicable in very young children, but require to be made smaller than they are drawn.

the rapid healing of the rupture are, on the part of the patient, sharp attacks of coughing, as in tussis convulsiva, or attacks of retching and vomiting, by which, as we have already seen, not only air, but mucus and bits of food may be forced upwards from the pharynx. On the other hand, injudicious therapeutical measures may induce inflammation and suppuration of the edges of the wound, and thus actually cause a loss of substance in the membrana tympani, so that an opening, and even an extensive chronic suppuration may remain behind; warm poultices and irritating instillations are the most common causes of such injuries.

As we have already seen, the whole catarrhal process in the middle ear is, in the majority of cases, the result of the readily occurring closure of the Eustachian tube, and we are justified in once more calling attention to the action of such a closure. With a disturbance of the ventilation of the osseous middle ear, the vessels and soft tissues of this cavity are subjected to a suction from the rarefied air which surrounds them, while the drum-membrane, yielding to the greater pressure from without, sinks inwards. Remembering now that, in childhood, the tympanic mucous membrane is unusually tumid and rich in blood-vessels, and also that the amount of air in the middle ear is very small at this age, since the petrous bone lacks, except the mastoid antrum, the numerous pneumatic cavities which are developed later, it will be understood why the mucous surfaces so rapidly are brought in contact, for instance, the inner surface of the drum-membrane with the promontory, and why, owing to this contact, extensive adhesions so readily occur.[1] From these peculiar relations,

[1] The fact should be emphasized here, that very often cords and bands are found upon the different walls of the tympana of children, which evidently date from fœtal life when the embryonic connective tissue fills the whole cavity. (Urbantschitsch, Archiv für Ohrenheilkunde, viii., p. 59, and Wendt, Archiv für Heilkunde, xv.) Even if these appearances are not strictly pathological, they favor the development of further adhesion and connections in case of any later pathological process.

it is also evident that the mucous or serous exudation in the narrow tympanum must exert a very intense pressure upon the elastic and yielding walls of the cavity, the drum-membrane, and labyrinthine fenestræ, and give rise, in one case, to severe pain, and, in another, to the well-known nervous or cerebral symptoms which an increase in the hydrostatic pressure in the labyrinth produces, such as dizziness with vomiting, stupor, or fainting—all which symptoms are, as a rule, only relieved by a rupture of the drum-membrane and the evacuation of the secretion. From this it is evident that, especially in childhood, sub-acute catarrhal affections are very common, and by them there may be produced gradually a change in the size and structural relations of the ear, which must necessarily lead to a gradually increasing diminution in the conducting power, and thus cause a progressive deafness and increase the evil unless we are able to alter the conditions which produce recurrences of the pathological process.

From the preceding considerations, it will be readily understood that the therapeutics of this disease should by no means be confined to a purely local treatment of the ears, nor to a simple correction of the general health, and, above all, the condition of the nasal and pharyngeal mucous membrane requires careful attention.

In regard to the latter, from the preceding deductions it is evident that, in a very large majority of the cases, the condition of the nose and pharynx must be conceded to be the cause of the ear-disease. We have already spoken of the very great advantages of the nasal douche, and of the method of its application in the chapter upon acute catarrh; in chronic catarrh, its long and continuous use is especially indicated. To prevent the fluid which enters the nasal cavity from forcing open the Eustachian tubes, an accident which may occur when the free exit of the fluid is hindered by impassability of the other nostril and it collects in the naso-pharynx, a little luke-warm water

should be snuffed up each nostril from the hollow of the hand, or dropped in from a sponge, and the child be directed to blow out the air and mucus from each side, while the other is closed with the finger. It is also a good plan to begin with the nasal douche always on the least pervious side, and the more restless the patient the more often should the stream of water be interrupted, either by compression of the rubber-tube, or by removal of the end from the nose, in order that the fluid may not enter the tubes during a contraction of the muscles. With very nervous or disobedient children, it will sometimes be of advantage for an adult or another child to allow the process to be shown in the presence of the patient. It is inadvisable to force the nasal douche upon an excited or screaming child; it should first be brought to reason. Bad and insufficient discipline is often avenged upon children in case of disease in a painful manner, and it often enough occurs that children become deaf because their mothers are foolish.

The inhalation of water, milk, or medicinal preparations from the hand is often necessary as a preparation for the nasal douche, but the same method is often of undoubted value after washing out the nose or, in many cases, even without this latter procedure. Here again it is also advisable for an adult to show the child how to sit and bend the head backwards, and how to draw the fluid from the hand into the nose so that it shall run into the pharynx and mouth, and from there be expectorated. A very strong inhalation upwards is to be avoided, because such will often produce headache. In addition to the indifferent solutions, such as salt-water and diluted milk, which are commonly used in the nasal douche, the various medicinal solutions can also be applied, but should never be made too strong.

The nasal douche should never have a fall of more than one to one and one-half feet, and the washing of the nose

by syringes or any form of pump is only exceptionally indicated. Care should be taken to follow out the advice of Sæmann[1] and Gruber[2] not to press the solutions either in small or large quantities with such force through the nose that they shall be driven into the ear. This method of syringing is so forcible and its action so beyond control, in that it often extends to the healthy ear, that it is only advisable under special circumstances, as, for instance, when there is a perforation of both drum-membranes. If it is necessary to wash out the nose, and the only instruments at hand are a rubber balloon or a syringe, one should syringe slowly, and carefully interrupt the stream frequently, and, above all else, avoid any obstruction to the stream, such as is caused by a bulb-pointed instrument filling the nostril, or by any closure of the opposite nostril. When there is a great deal of mucus, and the child does not understand how to blow the nose, air should be driven in forcibly from a syringe or from an air-bag, in order that part of the obstructing secretion may be evacuated either into the pharynx or through the other nostril—a procedure that, in young children, is extremely useful as a preparation for the nasal douche.

In cases in which the nasal douche is, from any cause, contra-indicated, as, for instance, when one nostril is closed from malformation or granulations, or where it is desirable to apply medicinal solutions to the mucous membrane in small quantities or minutely divided, a finely perforated tube can be introduced for douching the pharynx, or an atomizing apparatus may be used. When it is desired to spray the anterior part of the nasal cavity, the atomizers with short conical ends are useful; but if it is desired that the finely-divided fluid shall reach far backwards, an instrument must be used the tip of which ought

[1] Deutsche Klinik, 1864, N. 52; 1865, N. 2 u. 5.

[2] Idem, 1865, N. 38 und 39, und Gruber's Lehrbuch, p. 270. Author's Lehrbuch, p. 242.

to be a tube long enough to reach the naso-pharynx. The concentric double tubes, on the round end of which the air and fluid meet, should have a length of 11 ctm. and a thickness of 3 mm.[1] This atomization of fluids, such as solutions of soda, is of special value where adherent scabs and crusts or the dried secretion from ulcers are adherent to the walls, as these are not readily removed by the nasal-douche, even when used by the quart. They are also useful for the application of medicinal solutions to the mucous membrane which has been previously cleansed by the nasal douche. The atomizing tube, when its opening is directed upwards, is much more certain to reach the vault of the pharynx and the pharyngeal tonsils than the nasal douche, the stream from which does not reach so high if the exit through the choanæ is perfectly free. Instead of the curved brush or sponge introduced through the mouth behind the palate, a method which is often impracticable with children, drops of any desired fluid, such as solutions of nitrate of silver, may be atomized over the mucous membrane of the nose by attaching the cork of the above apparatus and its connected tubes with a small cylindrical glass vessel about 8 cm. long, in which the fluid to be used is placed.

For some cases of chronic nasal and naso-pharyngeal catarrh, the use of sal-ammoniac vapor in statu nascenti[2] is very beneficial. Snuffs and salves are only applicable to the anterior part of the nasal cavity. The former are often undesirably irritating, and are not to be depended upon: but the application of salves and the introduction

[1] This atomizer for the naso-pharynx, which is equally useful in treating the lower pharynx and larynx, was described and figured by the author in the Archiv für Ohrenheilkunde, Vol. xi., p. 36, 1876. (It does not differ materially from the smaller hand atomizers now in common use in this country, consisting of a double rubber-bulb air-pump, a bottle, and a straight atomizing tube, with an opening upwards.—Trans.)

[2] Vide Author's "Eine weitere Verwendbarkeit der Zerstäubung von Flüssigkeiten." Arch. f. Ohrenheilk., xiii., p. 200.

of oiled compresses where there are ulcerations and incrustations in the nostrils are very useful. In certain cases, and not simply those of hyperplastic catarrh alone, small quantities of powdered alum blown through straight tubes, or through the catheter into the nose are advisable; in still other cases, cauterization with lapis mitigatus on bent silver rods, which can be passed upwards from the mouth, are most serviceable.

For the removal of the large vegetations which are found with hyperplastic catarrh, various operations have been recommended. Wilhelm Meyer[1] uses for this purpose a ring-shaped knife, with a long flexible shank, which he introduces through the nose, and, fixing the vegetations by means of one finger introduced through the mouth, then cuts off the growths. The bleeding is always profuse, and immediately after the operation the coagula are removed by thoroughly syringing the nose. Cauterization or repetitions of the operation are frequently necessary. Justi,[2] instead of the ring-knife, used a sharp spoon for scratching away the vegetations. Zaufal[3] introduces small wire-snares through his naso-pharyngeal specula for removing hypertrophied pharyngeal tonsils or other growths. Through these same specula he applies caustics or the galvano-caustic snare. The use of the galvano-caustic for operations in the naso-pharynx has been more especially advocated by Voltolini, but good results from singeing the mucous membrane in hyperplastic catarrh have been several times reported by Michel[4] and Schwartze.[5]

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[1] Arch. f. Ohrenheilk., viii., p. 241. Illustrations of the instruments in Taf. II. Also Politzer in der Allg. Wiener med. Zeitung, 1875, N. 3 u. 4.

[2] Deutsche Zeitschr. für Chirurgie, 1876, N. 4.

[3] Prager med. Wochenschrift, 1877, N. 1–3.

[4] Deutsche Zeitschr. für Chirurgie, Vol. II.

[5] Archiv für Ohrenheilkunde, x., p. 251.

Some of the already-described methods of medication are, mutatis mutandis, applicable to the lower pharynx, such as the atomizer, both for long-continued sprinkling of the mucous membrane and also for applying a few drops of solutions of silver nitrate or similar substances, although these latter can be equally well applied to the lower pharynx by means of a brush. Gargles are, of course, very frequently in place; but it is of much greater importance how they are used than of what they are composed. The majority of patients require to be shown how to gargle properly, and children especially are apt to toss the fluid backwards and forwards between the teeth and the tongue, so that the deeper regions for which the application is intended are very slightly or not at all touched. For proper gargling it is necessary that the patient should sit or even lie with the head bent backwards, and, allowing the fluid to pass deeply backwards, should then make the motions of swallowing, but without allowing the liquid to pass into the œsophagus. With energetic but interrupted swallowing-motions, as described, the fluid reaches not only the deeper parts of the mouth, pharynx, and tonsils, but as the result of the powerful muscular contractions and of the stretching of the mucous membrane, the mucus upon the walls and in the mucous glands is separated and pressed out, so that it can be expectorated. With this method of gargling the retching produced by the to and fro movement of the uvula is wanting, so that the procedure is less irritating than the common method. The composition of gargles which are adapted to the various conditions need not be enumerated.

It frequently happens that the palatine tonsils, which are enlarged and subject to inflammations with abscesses, require special attention. Such often keep up a chronic inflammation of the pharynx just as a foreign body would, producing mechanical irritation and disturbances of circulation; they also interfere with the movements of the

palate, and, by pressing its posterior surface upwards against the tubal orifices, narrow or even close those passages. In children and young persons, the removal of hypertrophied tonsils improves the condition of the ears and of the hearing often in a marked degree, and is always favorable to the chronic pharyngeal and nasal catarrh. After the operation, the subacute attacks, with earache and increased deafness, which have previously been very frequent, either cease entirely or are much less common, and the pharyngeal and nasal cavities yield much more readily to the local therapeutics which before the operation were useless. In the children of families where there is an hereditary tendency to catarrhal deafness, enlarged tonsils should be early removed as a prophylactic measure, even when the ears are intact. It is well known that the extirpation of hypertrophied tonsils has a favorable influence on the articulation and voice, and also upon the position of the mouth and the facial expression, that after the operation children breathe much deeper, and consequently that the chest becomes more fully developed, the blood richer, and the child, previously pale and without appetite, improves in its whole constitution. If the enlarged tonsil is very soft, some improvement can be expected from iodine in gargles, and from frequent paintings with the same, long continued. Incisions and scarification are of only temporary value for fresh inflammation or for the evacuation of pus and the inspissated secretion.

Fahnstock's tonsillotome works admirably for children with whom it is impossible to use a knife; the larger tonsil should always be first removed, as often after one operation both will and obedience are lost for a time, but, of course, it is better, where possible, to remove both at one sitting. Ice in large quantities is an excellent styptic and antiphlogistic. I have never yet seen a disagreeably profuse bleeding in children. My young colleagues need not be frightened if a sloughy or diphtheritic deposit is

visible on the cut surfaces for a few days, and need not take special measures against it.

In regard to the local treatment of the ear necessary in chronic catarrh, the air-douche is, above all else, the most important agent. By its means the mucous surfaces of the cartilaginous tube are separated from each other, and the serous or mucous secretion, both in the tube and in the middle ear, which has been unable to pass downwards, is scattered. As the result of this scattering over a larger surface, absorption into the blood and lymph vessels takes place more rapidly; immediately after the inflation the ciliæ of the tube, previously gummed up, resume their function, and by their normal downward movement carry the secretion away. By the opening o the tube, the air which has been shut up in the tympanum is brought into connection with the air of the pharynx, and the previous difference in the density of these is removed. The compressed air forcing its way into the tympanum, presses the drum-membrane outwards, and thus may stretch or even tear apart abnormal connections and adhesions, as is often recognized by a subsequent examination of the drum-head. Such an examination often shows also, as the result of the air-douche, that the fluid in the tympanum has been filled with air-bubbles, or that the secretion is bulging outwards in some circumscribed spot of the membrane, as has been already described, or that the appearance of the drum-membrane is wholly changed in its color and position—all of which changes frequently produce an astonishing improvement in the hearing and other aural symptoms. Of course, a large part of the effect produced by the compressed air is merely temporary, but very often after one inflation a change for the better is observed, and it is a great gain for the physician and the friends to have a distinct proof of the possibility of treatment. If the improvement first effected remains but a short time, the necessity of a repe-

tition of the procedure and a continuous treatment for some time is indicated.

If it is possible to use the catheter, we can with it localize the action of the air-douche more certainly on the affected ear, and are much better able to increase or diminish the force of its action, according to the special case. We have already called attention to the fact that the catheter is of a certain value as a probe for the nasopharynx. In children between six and ten years of age, we are often obliged to content ourselves with the simple Politzer's inflation, the advantages and the ready application of which in childhood have already been described. During the latter part of the treatment, often more can be gained than in the beginning, as the nasal cavity improves in its permeability and irritability. With severer and older diseases, the catheter is the more necessary, as, by its means, medicinal fluids and vapors can be applied to the middle ear, and some such medication is in these cases absolutely necessary. As in this treatment special experience in aural diseases is necessary, we content ourselves here with merely calling attention to the fact. It will also be understood, from what has preceded, that paracentesis of the drum-membrane is very often desirable for the rapid evacuation of fluid secretion; the operation is, however, absolutely necessary when, in spite of repeated air-douches, the fluid in the tympanum does not disappear, or the improvement from the inflation continues to be merely temporary.

The advice necessary for the hygiene of children suffering from chronic aural catarrh will be understood from what has already been said on the etiology of the disease. Air, either bad in itself or impure from the expiratory exhalations of other persons, has been shown to be injurious to the mucous membrane of the nose, and, therefore, to the ear, and is a very common cause of the disease under consideration, or, at least, it keeps up the

pathological process. It is certain that children are frequently thus exposed in their living and sleeping rooms, and almost always in their school-rooms, and that the physician, in fulfilling his duty of preventing disease, should have a watchful eye in this direction; the effect of these influences is still but little recognized, and rarely considered in the arrangement of schools.

The more the attention of the physician is devoted to the prescribing of medicine, the less likely he is to regard the hygiene, and yet this latter is by far the larger and more important field of action. Especially in regard to the disease we are here considering, careful attention to the air in which the child lives, sleeps, and studies will prevent much injury, and be of much greater use than prescribing the customary cod-liver oil and salt-water bathing, although both of these are, under certain circumstances, advantageous.

We have already said that the mucous membranes of the head are often affected by active congestions and mechanical irritations, whether produced locally or dependent upon extensive disturbances of the circulation, and that the ear may be affected by pathological conditions of the body, and especially of the circulatory system. Of course, our therapeutic measures must often be directed to such general diseases. With a decided or probable syphilitic or scrofulous dyscrasia in the child, the appropriate internal and local treatment is absolutely necessary, and need not here be particularized, except so far as to call attention to the fact that the necessary local applications to the nose, pharynx, and ear, although the more important of the two, are apt to receive less attention than the internal medicines and baths, which are, at the best, merely an efficient aid to the treatment.

Chronic Inflammation of the Middle-Ear with Suppuration or Purulent Chronic Aural Catarrh, Otitis Media (Purulenta) Chronica.

We pass now to the higher forms of chronic middle-ear catarrh in which the secretion is chiefly purulent. The characteristic of this variety of inflammation is rather a partial destruction than a thickening of the tissues, although this latter may also occur; there is also a tendency to softening and inflammatory atrophy, which the simple mucous form of the disease does not show. The affection is generally described as "otorrhœa with perforation of the drum-membrane," and was commonly called by the older authors "chronic inflammation of the drum-membrane with perforation." The important feature, however, is by no means the opening in the drum-membrane, but the purulent inflammation within the cavity. If this latter ceases, as a rule the loss of substance in the drum-membrane is filled up if it is not too large, and if the outer and inner edges of the perforation have not become adherent to each other. In some rare cases in which the drum-membrane is not involved, the purulent secretion of the middle-ear finds an exit through the bone behind the auricle, or through the walls of the meatus, forming fistulæ at those spots.

The chronic purulent catarrh of the ear is usually the sequel of an acute inflammation of the middle ear where, as the result of a very severe or specific disease (acute exanthemata, diphtheria, croup, typhus), or on account of a constitutional tendency to suppuration (scrofula, syphilis), the tympanic secretion is rather purulent than mucous, or where the acute catarrh has been treated by injudicious poulticing. We have already seen that under unfavorable influences an otitis externa or a myringitis may lead to ulceration of the drum-membrane and to the transmission

of the purulent process to the tympanum. Finally, it should be said that not infrequently children with old purulent catarrhs are seen in whom no history of an acute beginning of the disease can be obtained. It may be that sometimes the suppurative process is insidious in its course, but we should remember that the symptoms of an acute otitis media in children may be easily overlooked or falsely interpreted.

A very considerable proportion of the chronic otorrhœas with perforation of the drum-membrane which are seen in adults originate in childhood; and in general it may be said that chronic purulent aural catarrh is a very common disease in children. Even immediately after birth, such a suppuration of the ears is sometimes noticed, and must be regarded as congenital,[1] having been produced in utero or during delivery. In syphilitic children, very early otorrhœas are particularly often observed.

The complaints of patients with chronic purulent aural catarrh are frequently very slight, especially if the deafness, which in itself is very variable, is only of moderate degree or only on one side. Pain usually exists only when from some injurious influence the chronic inflammation takes on a subacute or directly ulcerative character, or when mechanically, from a drying of the secretion or a swelling of the tissues, the pus which is secreted in the deeper parts is retained, or finally when, from an extension of the disease, an abscess has developed in the neighboring parts. If no such painful warning occurs, the suppuration of the ear and the offensive discharge are often for years regarded by the parents (and frequently also by the physician) as an unimportant and slight affection. Not uncommonly a protest from the neighboring scholars in school, incommoded by the offensive

[1] Wendt (Archiv für Ohrenheilkunde, iii., p. 169 and 170) and Zaufal (Wiener Med. Wochenschrift, 1868, No. 23) report cases of such congenital suppurations of the ear.

odor, first directs the family physician's attention to the disease.

When the ear is syringed, it is necessary that the fluid should be received in a basin and carefully examined. The presence of flecks or lumps of mucus in the water shows with certainty that the middle-ear is opened, as the meatus never produces mucus. Usually, a perforation exists in the drum-membrane, and this may be diagnosticated with probability merely from appearance of mucus in the water. If there is any doubt whether the jagged flecks which are floating in, but do not dissolve in the water, consist of mucus alone, or whether they also contain pus, the microscope must decide. The microscope can also settle the question in regard to the presence of portions of tissue and of minute particles of bone in the discharge. The offensive and pungent odor is by no means an indication of caries; but now and then a sandy feeling to the finger of the deposit in the basin renders the diagnosis of caries possible. Frequently, the insoluble masses in the water will be found to be collections of pus or of epidermis, the latter being sometimes thrown off in thick whitish or mother-of-pearl layers from both meatus and middle-ear. After syringing, it is well to dry the meatus thoroughly, and this can be best accomplished by wrapping wool around an indented stick. The examination of the deeper parts is thus rendered more easy.

After syringing the ear, an examination will often show, in those children which have not been kept clean, and in whom the secretion has been very abundant, that the orifice of the meatus and the neighboring skin are in a state of erythema, or even of eczema, from the constant maceration by the decomposed pus. Still more commonly, the lining of the meatus will be found, especially in its lower wall, superficially macerated. Even after syringing, there are often numerous discolored crusts of dry pus mixed with epidermis adherent to the posterior upper wall which

cannot be immediately removed. Only after the removal of these is it possible to get a full view of the deeper parts. Not infrequently, in the deeper parts of the meatus, and concealed beneath these crusts, are flat or projecting granulations which bleed with any violent syringing or upon the slightest touch with brush or cotton; they are the cause of the dark color of the pus and of the crusts, and the source of the blood which is often mingled with the discharge.

The drum-membrane, as much of it as remains in this disease, is always changed from the normal condition. As the result of maceration and of hypertrophy of its epidermal layer, it appears opaque, without polish, and less sharply defined from the meatus than is natural; it is usually more or less thickened in all its parts, and often contains a deposit of lime and fat-molecules, so that both in color and appearance it is very much changed. In its position and curvature it is often very abnormal; where there is a small perforation and great thickening, it is more nearly plane, while as the result of adhesions from its inner surface or from the edges of the perforation to any part of the tympanic cavity, it may be drawn inwards either in a circumscribed spot, or throughout its whole extent. When the perforation is central and tolerably large, the manubrium and the remaining membrane, having lost their normal support, sink inwards towards the tympanum; and this change in position is very favorable for the development of an adhesion between the end of the manubrium mallei and the promontory—the nearest point of the tympanic wall.

The perforation, which is always round, appears very differently in different cases. If the opening in the drum-membrane is small, so that only a little light can fall into the tympanic cavity, it appears dark, or even black, like a round spot of pigment upon the membrane.[1] The larger

[1] It should be stated here that inexperienced observers often report dark spots on the drum-membrane which a more thorough illumination shows do not exist.

the opening is, the greater is the extent of tympanic mucous membrane exposed, which, when freed from mucus and pus, appears in some cases bright-red; in others, covered with fine or large granulations; in some cases, of a pale-pink color with the injected capillaries visible; in others, of a gray color. The edges of the perforation in the drum-membrane appear, in cases of old disease—a condition, however, which is rarely met with in children—thickened and covered with skin, or else pale and thin; when congestion is present, they appear more or less red, and are sometimes irregular in ontline from the existence of fine granulations. Any secretion adhering to the edges or covering the perforation usually pulsates synchronously with the heart, and the reflex from this rhythmical pulsation is readily seen. When a large part of the central portion of the membrane has been destroyed, the lower portion of the manubrium, in some cases even up to the processus brevis, is lost through caries; the short process itself, and the surrounding portion of the membrane, is, as a rule, retained even when all the rest of the membrane is lost. The hammer, either by disintegration or in toto, comes out with the pus, and not very infrequently the incus is also lost in the same way.

It is not always easy, even after the most thorough cleansing of the ear, to interpret the appearances which are presented, for, as the result of the continuous inflammation, the different parts may lose the color, appearance, and position which are their characteristics, and may be readily mistaken for other parts. As for instance, a portion of the drum-membrane becoming granular, and then being, from any cause, drawn inwards, can easily be mistaken for a granular mucous membrane behind a perforation, where the mucosa is so much swollen that it lies directly behind or projects into the perforation. It sometimes occurs that a small polypus from the mucous membrane projects through a perforation, and so completely

conceals the edges of the opening that it is mistaken for a granulation upon the drum-membrane. In many such cases the appearances can only be understood by directing the patient to inflate the tympanum by Valsalva's method while the physician is inspecting it, or else by examining the drum-membrane directly after the air-douche. If the Eustachian tube is pervious, inflation forces the drum-membrane outwards, and separates it from the parts lying behind, while, at the same time, any existing secretion is expelled with a loud hissing or whistling sound, which proves certainly the existence of a perforation. The use of a plane mirror with sunlight will often give the best view, and it is advisable to hold the reflecting mirror at quite an oblique angle with the deeper parts of the meatus, since it is then possible to illuminate the superficial and the deeper parts one after the other, and the depth at which the different objects lie can thus be better determined. In not a few cases, it is possible to determine the exact condition only after frequent examinations and after the tissues have been, by treatment, partially restored to their normal state. An inexperienced hand should never, in such cases, be led to probe the deeper parts in order to satisfy his impatience, as the sensitive tissues can be easily injured, and it is even possible that a softened carious spot may be perforated, and the cochlea or vestibule laid open.

On the other hand, the use of the probe can scarcely be avoided in diagnosticating the presence and position of aural polypi which are found commonly in the form of mucous polypi,[1] the product of a chronically inflamed and suppurating mucosa of the tympanum. When they are large, they are visible near the orifice of the meatus as

[1] The most thorough histological investigations on the different forms of aural polypi are given by Steudener (Archiv für Ohrenheilkunde, iv , p. 199, 1869), with illustrations. Full accounts will be found in the text-books on the ear; they cannot be given here.

bright-red, soft tumors with granular or ragged surfaces. They always increase the amount of the pus, often from their vascularity and friability bleed, and from their mechanical obstruction to the evacuation of the pus secreted in the deeper meatus endanger the life.

When large polypi are present, the deafness is almost always very great, but, except with this complication, the loss of hearing in otitis media chronica may be slight, and hardly inconvenient, in spite of the existence of perforation and suppuration. The amount of hearing is very variable and subject to sudden changes, depending upon the degree of swelling in the tissues, the amount of secretion, the state of the weather, and the condition of the naso-pharyngeal mucous membrane. The important question in the disease, as in simple chronic catarrh, is not whether the drum-membrane is perforated, but in how far the conducting apparatus within the tympanum performs its functions normally, and in what condition the mucosa of that cavity is. When the secretion is abundant, the degree of deafness depends upon whether the mucus or pus lies upon parts which are of importance in the conduction of sound or not. The sudden changes in the hearing following movements, such as sneezing, Valsalva's inflation, shaking of the head or ear, are referable to the alterations of the semi-fluid secretion from one spot to another.

The results produced by a long-continued suppuration of the middle ear are seen not only within the ear itself, but frequently also in the general organization. Purulent secretion in the depth of the ear, being submitted to all the influences favorable for the development of putrefaction, must necessarily decompose, and will then have a softening, macerating effect, and produce irritation and destruction of the tissues submitted to its influence. This influence will be seen on the soft tissues, sometimes as ulcerative destruction, sometimes as infiltration and granulations; and upon the bone, in one case as caries and

necrosis, and in another as a hyperostosis. In the same ear will be often found, side by side, destruction of the tissues with hyperplasia and pathological growths.

By either of these processes, hypertrophy or destruction, the functions of the ear as an organ of special sense must suffer, and often incurably; but, in addition to this, it is well known that suppurative inflammation of the ear may threaten the general health and life of the individual. The general diseases secondary to an otitis arise from the capillary system, or from an extension of the inflammation and putrefaction to parts in close relationship to the ear.

The frequency of secondary affections produced through the capillary system, either extending within the blood-vessels themselves or along their walls, is due to the peculiar arrangement of this system in the hard and soft tissues of the ear. From the skin of the meatus and from the mucous periosteal lining of the middle ear, both arterial and venous branches pass into the contiguous bone; in a similar way the capillary system of the petrous bone, both the arteries and the veins, are in direct connection with the dura mater, so that the vessels of the latter are in communication, through the capillaries of the bone, with the soft parts of the external and middle ear. The blood-vessels of these two regions, the ear and the brain, are also directly connected through the diploëtic veins of the temporal bone which discharge into the sinuses of the dura mater (especially the sinus lateralis and sinus petrosus superior), and also through the venæ emissariæ which, arising from the sinuses, pass through the bone and discharge their contents into the external veins of the head. From these mutual capillary connections between the endocranium (dura mater) on the one hand, and the pericranium (skin of the mastoid, squamous portion of the temporal bone, meatus, and lining of the middle ear) on the other hand, and from the connections of each of these regions with the capillary system of the temporal bone

itself, the reason is evident why pathological processes in the soft parts of the ear may so readily produce softening of the contiguous bony tissues, or lead to secondary processes in the dura mater or its sinuses, or else by extension along the vena jugularis may cause pathological conditions anywhere within the circulation.

The results of otitis by extension through the blood-vessels are seen within the skull in the form of pachymeningitis purulenta, or of inflammation of the sinus-walls (phlebitis). If, however, the vena jugularis contains obstructing or putrefactive matter and bacteria, these may be carried forward into the lungs or other distant regions, and produce the well-known embolic or septic disturbances which express themselves sometimes as metastatic abscesses, sometimes in the form of a typhoidal or pyæmic fever, and on the autopsy table are recognized as infarcts, purulent deposits, and gangrenous inflammations in the various organs and cavities. Surgeons and pathological anatomists have long known that the conditions for the development of fibrin-clots, and their transmission through the circulation, were especially favorable in the diploëtic cavities of the skull, and that, therefore, injuries and diseases of these bones frequently caused purulent and putrefactive diseases in distant parts of the body. It is worthy of special notice, in this connection, that the petrous bone of a child possesses much more diplöe than that of an adult. The entrance of atmospheric air, which occurs through the perforation of the drum-membrane in purulent aural catarrh, predisposes to the coagulation of blood in the injured vessels and to putrefaction and the entrance of bacteria, which act as the exciters of infectious diseases and of fever.

The extension of an inflammatory or putrid process from the soft tissues of the ear to the dura mater and its sinuses, which we have just described as taking place often by means of the blood-vessels, may also occur through the

connective-tissue elements which pass through the bone connecting one of these regions with the other. This may take place through the sheaths of the nerves along which, as is well known, pathological processes very often creep, and also through the bundles of connective tissue which are particularly well developed in the child's petrous bone and separate it into several distinct parts. Attention should also be called again to the fact, that through the fissura petroso-squamosa, along the roof of the tympanum, there is always present an extension of the dura mater to the mucous membrane of the tympanum and of the antrum mastoideum. This bundle of connective tissue, which is extensive in childhood, contains large branches of the arteria and vena meningea, and remnants of it remain in in the adult; it is certainly in childhood very frequently the means of extension of a purulent inflammation of the middle ear to the interior of the skull.

When a pachymeningitis, either of the convexity or of the base, is found at the autopsy of a child, the roof of the tympanum, the porus acusticus internus and the canal of the facial nerve should all be opened from above by means of bone forceps—not by a saw, which injures the appearances—and it will be discovered that some inflammations of the membranes, which had been regarded as idiopathic, were in reality secondary to a purulent otitis media. It should be remembered that the internal auditory meatus (porus acusticus internus), which affords a passage to the facial and auditory nerves into the petrous bone, is lined by a continuation of the dura mater, and that the inner end of this passage is not far from the tympanum, being separated from that cavity only by the two labyrinthine cavities, the cochlea and vestibule. Should the pus or inflammation in the tympanum break through the delicate structures which close the oval and round fenestræ, a direct passage is formed into one of these labyrinthine cavities, and the dura mater is then only separated

from the disease by the thin perforated lamella of bone through which the minute fibres of the nervus acusticus are distributed to the structures of the cochlea and vestibule. It is also perfectly established that, without any carious destruction of these dividing walls, a pathological process may be transmitted along the neurilemma from the labyrinth to the dura mater within the porus acusticus internus.

There is, however, a still nearer and more direct way from the tympanum to the dura mater. This latter membrane lines the canal of the facial nerve (canalis Fallopii), which is a branch of the internal auditory canal; for quite a distance in its course it is separated from the mucosa of the tympanum only by a thin, transparent and often defective plate of bone before dipping down through the mastoid process. This relationship explains why facial paralysis is by no means uncommon during an otitis media in both children and adults. Without any such paralysis, the supurative inflammation of the tympanum, or of the mastoid cells, may extend along the sheath of the facial nerve in the form of a perineuritis, and thus reach the dura mater in the Fallopian canal and in the porus acusticus internus. Just such causes of pachymeningitis as these, acting within the substance of the bone, are not visible upon the external surfaces of the petrous bone, and hence it is always necessary to open the tympanum from above with bone-forceps, and also the internal meatus, so as to inspect the nerve-trunks and see whether there is any abnormal development of vessels or any trace of purulent or fibrinous exudation. If any suspicion of purulent inflammation is found, the best course is to follow the facial nerve from the tympanum outwards, opening its canal from above with forceps and chisel. As the internal meatus is approached, the bone on each side of the canal should be removed, and in this way the vestibule and cochlea will be opened from above and can be inspected. After the dura

mater, along the Fallopian canal and the porus acusticus internus, has been thus exposed, it should be laid open in order that, the nerves being removed, the floor of the canal may be inspected. Only by such an examination as this, which, by the way, is much easier to make in children than in adults, can a correct judgment be formed in regard to whether a purulent meningitis was produced by the ear or not.

For all of these inflammatory, embolic and septic processes, which, as the results of chronic suppuration of the ear, so often end fatally, it is clear from what has been said above that a carious condition of the petrous bone is not necessary for their production. A suppuration of the soft parts of the ear is alone sufficient to produce such secondary processes in the various ways described, and this should be doubly emphasized, as physicians are often inclined to consider only a caries of the petrous bone, but not an otitis purulenta, as a serious and dangerous affection although an innumerable number of accurate autopsies have shown the absence of any caries in the temporal bones of patients who undoubtedly died from chronic suppuration of the ear. In childhood it is certain that caries of the petrous bone is found relatively often, but it is impossible to decide fully whether the otitis purulenta in itself more readily leads to exfoliation of the bone at this age, as is very possible, or whether the petrous bone in children becomes carious because the purulent aural disease is not sufficiently appreciated, and therefore opportunity is given for the development of molecular necrosis. At the present day it is generally accepted that caries is much less commonly developed as a primary disease from an ostitis or osteomyelitis than that it is produced by an inappreciation and bad treatment of inflammations and suppurations of the neighboring soft tissue.[1] The same holds true in the ear.

[1] Compare Volkmann, "Die Krankheiten der Knochen" in Pitha und Billoth's Handbuch der Chirurgie. Erlangen, 1865. II. 2, 1, p. 312.

Aside from the fact that caries of any bone greatly endangers the general constitution of the patient,[1] the existence of carious spots in the temporal bone is especially liable to cause an extension of inflammation to the neighboring parts, and particularly predisposes to diseases of the vascular system. No bone of the skull or of the spine so often becomes carious as the temporal bone, and none lies in so close relationship with many important parts (dura mater, brain, sinus lateralis, vena jugularis, arteria carotis interna with its venous sinus), from all of which the auditory meatus and the cavities of the middle ear are separated merely by thin lamellæ of bone. Abscesses in the brain are the not uncommon result of otitis, those developing in the middle lobe being often associated with caries of the tympanic roof, those in the cerebellum with caries on the posterior surface of the petrous bone. The foul gases arising from the purulent collections in the deeper parts of the ear, and which can sometimes be recognized at considerable distances from their very disagreeable odor in the cases of children who have not been thoroughly instructed in the cleansing virtues of the syringe, may possibly contribute to the production of the inflammation of the brain-substance which must precede these brain-abscesses, and also of all the other above-described results of a suppuration of the ear. These gases are naturally diffused, not only through the auditory meatus, but in every direction, and must produce on the tissues exposed to them inflammatory degeneration and putrid decomposition. And here it should be said, that if these gases are shut up in the tympanum from closure of the meatus by secretion or by polypi, they will the more readily be diffused downwards through the Eustachian tube, and then, mingling with the air which enters the nose, be drawn into the lungs. If the lung and bronchial tissues

[1] The statistics of Billroth and Menzel show that 78% of all caries is associated with chronic diseases of internal organs.

are at all irritable, the inhalation for a long time of such foul gases cannot be innocent. Is it not possible that accurate observation might furnish such an explanation for some of the destructive and gangrenous processes in the respiratory system?

Within a short time the theory has found more and more supporters that acute miliary tuberculosis, and, possibly, the tuberculous processes in general, are to be regarded chiefly as infectious diseases proceeding from caseous masses situated in any part of the body. A long time ago, aural surgeons[1] called attention to the great frequency of acute tuberculosis of the lungs, intestines, and meninges in individuals who were suffering from otorrhœa. It is certain that the numerous cavities of the ear are particularly adapted for the retention of large purulent masses which gradually dry up and become caseous, and this is especially the case with the antrum mastoideum of children, which is about the size of a cherry-stone, and, as it lies behind and above the tympanum, easily collects the pus when the child lies on its back in bed. According to Buhl, tuberculous self-infection from caseous collections is most common in youth—at the time when the body is growing, and the formation of blood and lymph is active. It may be that, as yet, we have no idea how frequently the tuberculosis of children is dependent on purulent retention in the cavities of the ear. In order to get accurate statistics on the frequency with which tuberculous processes, especially in childhood, are associated with caseous purulent masses in the middle ear and antrum mastoideum, the cavities of the petrous bone which lie superficially just beneath the dura-mater, and which can usually be easily broken open with forceps, should be examined. If this were done, perhaps greater care would hereafter be taken to prevent the retention of pus within the ear.

[1] Author (Virchow's Archiv, 1859, vol. xvii., p. 79). Schwartze, Archiv für Ohrenheilkunde, 1867, vol. ii., p. 280.

In addition, it may be said that in most of the cases of "tuberculous caries of the petrous bone," described chiefly by French authors[1] as very common in phthisical children, there is possibly a misunderstanding and false interpretation of the appearances. The masses which have been described as "tubercles," were certainly, as a rule, only masses of inspissated pus within the enlarged cavities of the middle ear, and the ulceration of the drum-membrane and the otorrhœa did not proceed from these masses as the primary disease, but vice versa, the pus formed in the ear, not being carefully attended to, produced collections which gradually dried and became caseous, and resembled masses of true tubercle. The real connection of the phthisis with these masses in the petrous bones seems to have been rightly interpreted by the French.

From all that has preceded, it is very clear that there is every reason for being cautious in giving a PROGNOSIS in chronic suppurations of the ear, since it is impossible to determine, even in apparently favorable cases, whether, and in how far the pathological processes, which so often are fatal, may have developed in the deeper concealed parts. For truth and brevity, the saying of Wilde's on this subject has never been excelled: "So long as a suppuration of the ear is present, we are unable to say how, when, or where it will end or to what it may lead."

On the other hand, in every case of chronic purulent inflammation of the ear, but more especially when such occurs in childhood, very much can be accomplished by treatment. As a rule, we are able to prevent the retention of pus in the deeper cavities and its consequent dangers if not consulted altogether too late, and it is very often possible, even in old cases, by a long-continued and

[1] Rilliet et Barthez, Traité des maladies des enfants. Bruxelles, II., p. 489. —Nelaton, Recherches sur les affections tubercul. des os. Paris, 1837, p. 46, 70.—Grisolle, Presse méd., 1837, N. 32.

appropriate treatment, to improve the hearing, and not only diminish the suppuration, but gradually check it entirely, in which case the opening in the drum-membrane usually becomes closed by thin tissue. Considering the dangerous character of the disease and the favorable effect of therapeutic measures, there are few diseases in which the physician can do so much good and at the same time ward off so much evil. Even with appreciable caries, and when elevations of temperature with occasional chills or with continuous fever show that the general system has become involved, it is wholly unjustifiable to give up the case as hopeless, and to treat it passively. The local treatment should then be carefully attended to in order that the retained purulent deposits may be discovered and evacuated.

As the injurious effects of chronic otitis, both upon the ear and upon the general system, are referable to the retention of pus, treatment should be directed above all else (1) to the most thorough removal possible of all secretion which has already formed; but as such removal is not always possible, owing to the formation of the ear, (2) attention should be directed to the prevention of decomposition in the pus and tissues, and (3) to the gradual diminution in the formation of pus, and to improving the chronic catarrh of the tympanum.

The consideration of the first two indications must necessarily be diffuse. Thorough cleansing of a suppurating ear without syringing is almost impossible. In the selection of a syringe, care should be taken above all else that the end which is to be inserted into the meatus is not too thin and pointed, as it would thus cause pain; on the other hand, it must not be so thick and blunt as to close the narrow passage and prevent the return of the water. The physician should teach the attendants how the syringe should be held in order that the fluid shall reach the deeper parts (this is best done by resting the point on the

upper wall of the meatus at a right angle to the side of the head); the stream should also be used neither too strongly, too suddenly, nor too timidly, and in large instruments the pressure should be interrupted frequently. Very many ears do not heal, simply because the ear is insufficiently syringed, and the physician should always show how the operation is to be performed. If the secretion is thick and very firmly adherent to the walls, the meatus should be filled with warm water and kept so for some time, the patient lying upon the opposite side; in this way, the secretion is softened and more readily removed by subsequent syringing. Hard-rubber syringes with well-rounded, short cylindrical or slightly conical points, and with a projecting rim, by which they can be held between the fingers, are very good instruments. Rubber balloons, when not too small, or irrigators, if properly used, cleanse very well. Metal syringes are apt to be either too small or too heavy. In many cases, it is an advantage to draw over the point a bit of rubber tubing, allowing it to project about a centimetre; this brings the stream of water deeper in without its being necessary to pass the hard point of the instrument directly into the meatus.

In syringing the ear, a large amount of fluid should be used, but the operation should not be repeated too frequently—at the most once or twice a day—and with the syringing, dry-cleansing should be used regularly and frequently, according to the amount of secretion. This can be accomplished by passing as deeply as possible into the meatus well-compressed rolls of charpie or cleansed wool two to three centimetres long. Where decomposition has already begun, disinfecting substances, as, for instance, salicylic wool, can be used for this purpose every hour, or even oftener, and the dressings frequently changed, even during the night, if the secretion is abundant or the case particularly serious. Efforts should be made to keep the child lying on the affected ear, so that the pus may have

free exit during sleep, and less easily collect in the deeper parts. Too frequent syringing will readily produce swelling of the skin of the meatus and furuncles; on this account, after each syringing, the ear should be carefully dried and the dressings frequently changed.

The smaller the opening in the membrana tympani is, the more easily pus collects behind it, and the less readily can the stream of water reach the seat of the abnormal secretion. Under these circumstances, it is desirable that the pus should be regularly driven outwards from within, either by Valsalva's inflation, if the child can be taught to do it, or by Politzer's inflation. This should be done three times, at least, before and during the syringing, if not oftener. It is still better to inflate the ear by means of the catheter, and then drive fluid, drop by drop, into the tube, until it runs freely from the ear. In this way the middle ear can be most thoroughly cleansed, and the Eustachian tube, the natural outlet for the discharge, being opened, the most rapid improvement follows both in the general condition and in the character of the secretion. This method should be more frequently used with older children than is now common.

With what fluids shall the ear be syringed? Certainly with such as will check rather than favor the decomposing processes which develop in the ear. All substances predisposed to acid fermentation and those which contain parasitic spores are to be avoided, as are also stagnant and impure waters, which are often thoughtlessly used. All water used for syringing a suppurating ear should be previously heated to at least 140° F., as this temperature is necessary to destroy vibrios, bacteria, and their spores. It should then be allowed to cool in a closed vessel, or should be mixed with perfectly pure water. The syringe should be thoroughly cleansed daily with hot water before use. Of course, the ear should never be syringed a second time with the same water; but two vessels should be used

—one for holding the clean water and one for catching the water from the ear. Cool water is very unpleasant to the majority of patients, and usually causes dizziness. On this account warm water should always be used for syringing. When the tympanic cavity is opened, instead of simple water, a weak solution of salt is preferable (¾–1%),[1] and in very many cases, it is advisable to add to this an antiseptic or disinfecting mixture. Potassium permanganate, salicylic or carbolic acid are especially valuable, the former in very weak solution, the latter in gradually increasing strength, provided it does not irritate. A very useful disinfection of the ear can be accomplished mechanically by blowing air, either from a rubber balloon or from a syringe, into the meatus several times a day, and at each sitting continuing it till the air returning from the ear is no longer offensive.

In a certain proportion of cases, especially in healthy children, and where the disease has not been of long duration, such a thorough cleansing with methodical disinfection of the ear is sufficient to diminish the amount of pus and gradually reduce its offensiveness. The formation of pus may even cease entirely; the mucosa become healthy, and the hole in the drum-membrane heal, if it has not existed too long. In many other cases, however, the chronically inflamed and suppurating mucous membrane of the middle ear requires further applications, the most important of which are astringents.

In the use of these, care should always be taken that the medicament comes in direct contact with the affected tissues, and on this account it is necessary to precede their application by a thorough cleansing and drying of the ear.

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[1] Miescher, Jr. (Ueber die chemische Zusammensetzung der Eiterzellen in den Unters. aus dem Laboratorium von Hoppe-Seyler. Tübingen, 1871), und Burckhardt-Merian (Correspondenzblatt f. schweizer Aerzte, 1874, N. 20) assert that the addition of soda sulphate or magnesia sulphate to the water used in syringing is of advantage.

When the opening in the drum-membrane is small and the swelling of the tissues considerable, a simple filling of the meatus with the warm fluid is not sufficient, but the head of the patient being turned to the opposite side and held in this position for from five to twenty minutes, the solution should be poured into the meatus till the passage is full; the air should also be pressed out of the tympanum, in order that the solution may reach every part. A very simple method of doing this is to press the tragus inwards occasionally over the meatus. Another method is to condense the air in the meatus by means of a rubber-tube inserted air-tight, and blowing repeatedly into this from the mouth. Better than either of these, however, is inflation of the middle ear by any one of the three methods—Valsalva's, Politzer's, or by the catheter, which throws the instilled fluid about in all directions. As soon as the air passes through the perforation of the drum-membrane, it will be seen bubbling up through the fluid in the meatus, the level of which will immediately sink, showing that the astringent has taken the place of the ejected air.

In regard to the astringents which are useful for these applications, experience has shown that zinc sulphate is particularly good in solutions of $\frac{1}{3}$–1%. Copper sulphate is very much praised by some, but as it is in some cases very irritating, it should be tried at first in weak solutions ($\frac{1}{1}$–$\frac{1}{2}$%; i. e., 0.05 : 50 grams of water). Common alum is applicable only in very weak solution, but acetic alum can be used stronger. It should, however, always be prepared fresh. Silver nitrate in astringent strength, at the most 1–2%, offers no special advantage, and the persistent black discoloration of some of the parts, which results from its use, may interfere seriously with the inspection of the ear. It is also liable to stain the linen, to the disgust of mothers. In obstinate and old forms of the disease, healing may be much assisted by caustic solu-

tions of silver nitrate (4–10%).[1] These should generally be left in the ear but a short time, and should always be followed by neutralizing injections of salt water, and afterwards by pure water. With all three of these fluids, the methods already described for causing a thorough application to all parts should be carefully attended to. Cauterizations, which, in some cases, irritate very much, and in other cases not at all, should only be applied by the physician himself, and then only with the greatest discrimination in the cases. With granulations and caries they are not indicated. If the cauterizations are effective, an improvement will be apparent after the third or fourth application, the mucous membrane appearing less red and less swollen, and the secretion being less abundant.

Lead acetate and iron chloride are very efficient astringents, but both possess the disadvantage of forming deposits, which become attached to granulating or raw surfaces; and if they collect in quantities in the depth of the ear, may serve to retain the pus. They should, therefore, be used in purulent catarrh only in very weak solutions, and then only when the physician can daily inspect and remove any deposits. The liquor ferri sesquichlorati and acetum Saturni, in strong solutions, or even pure, are useful for painting flat or cockscomb-like granulations, such as often appear on the upper posterior wall of the meatus, close to the membrana tympani. To shrivel up some granulations, frequent applications of pulverized alum, which should be allowed to remain in the ear from one to three days, are useful. Pulverized alum should never, however, be given the patient himself for insufflation, as the powder forms with the coagulated pus a firm, stony mass, extremely difficult to remove, and behind which suppuration continues, and may do great mischief.

Small and very soft polypi may sometimes by these

[1] Schwartze, Archiv f. Ohrenheilk., iv., p. 1 und 233; xi., p. 121. Also Politzer, idem, xi., p. 40.

applications shrivel up and fall out; more commonly, however, an operation for their removal is necessary, and this can be performed with the least likelihood of injury to the soft parts by means of Wilde's snare.[1] The stump remaining after removal should be treated by pulverized alum, or better by silver nitrate fused on the end of a probe and pressed firmly into the tissue-growth till it all shrivels up. Necessary as the operative removal of aural polypi generally is, it will often be of little advantage to the patient if the fundamental disease of the tissues, usually a purulent catarrh of the middle ear, is not afterwards treated. If this is not done, the suppuration will soon become more profuse, and a new polypus will form.

Before leaving the subject of local treatment of suppuration of the ear with perforation of the drum-membrane, let us consider briefly the artificial drum-membrane, chiefly with the object of moderating the very extravagant expectations which are so often associated with the name. Efforts to find an artificial substitute for the destroyed membrane arose originally from the exaggerated importance which was attached to the hole in the drum-membrane. The earlier of these experiments were of German origin, and date back to the thirty-years' war. The best known instrument of the kind is that of Toynbee, described by him in 1853; it consists of a thin rubber disk to which is attached a silver wire about one inch long. This, pressed against the remnant of the drum-membrane, often produces a very great improvement in the hearing, but in many cases cannot be worn long on account of the noise made by the rubbing of the silver wire against the walls of the meatus during speaking and eating; it also frequently causes irritation or pain in the deeper parts, and both increases the secretion of pus and shuts it in. By

[1] Illustrated in the author's Lehrbuch, sixth edition, p. 508.

[2] An account of the different theories and experiments on this subject will be found in the author's Lehrbuch, p. 436.

far the most useful form of artificial aid is a small round pledget of cotton, moistened with an astringent mixed with glycerin, which can be passed in by means of a pincette or small metallic handle; this will, under certain conditions, produce the same improvement in the hearing as the artificial membrane, and is not injurious to a suppurating ear, but on the contrary beneficial if frequently changed. In children, if any cotton-holder[1] is used as a handle, it must be very short, so that it cannot be seen or touched outside, and, in fact, at this age any such artificial aid is rarely advisable, except in cases of bilateral deafness where the inflammation is already ended; in such it can be used during the hours of instruction if the patient and the instrument are under careful observation. By far the most important thing, however, is to diminish the suppurative inflammation by appropriate treatment, so that the perforation of the drum-membrane may heal; the hearing will then improve so far as the anatomical conditions allow.

The dependence of the pathological process in the ear upon the general condition of the nasal and pharyngeal mucous membrane is especially evident in purulent catarrh, because the exposed tympanum allows us to inspect the condition of the tympanic mucous membrane and its secretion. With every cold in the head and every congestion of the mucosa pharyngis which occurs in the child, the secretion of the ear is increased, and the swelling and redness of the tympanic mucous membrane are more marked. In this form of catarrh, it is, therefore, necessary to apply all the therapeutic and hygienic rules which we have shown to be necessary in simple chronic aural catarrh, both for the general health and for the naso-pharyngeal mucous membrane. Indeed, in this form of disease, where we are dealing not alone with the hearing, but often with the health

[1] This attachment, which originated with Hassenstein, is figured in Lehrbuch, p. 439.

and life which may be endangered by the continuance and extension of the suppurative process, all of the influences already described, without which the aural disease can be with difficulty, if at all, cured, are more necessary and important. The air-cure, with absence from school and living in a good, pure air and a milder and more sunny climate, will often produce wonderful effects on suppurations of the ear. It is frequently observed that an ear is not only improved by a winter in a milder climate, but that subsequent medical treatment can accomplish much more than was the case at first. When the naso-pharynx is the starting-point of the ear-disease, or when disturbances of circulation and nutrition are its cause, such an air-cure with a therapy directed to the general system brings about the best results. In many cases, the bath- and spa-cures are desirable; for the reason, however, that the children are then kept in the open air and are taken away from school.

When, in the course of a chronic otorrhœa, subacute attacks set in, antiphlogistic measures, as leeches and derivation to the bowels, are indicated at first; the ear should be frequently filled for a long time with warm water (ear-baths), and under certain conditions hydro-therapeutic applications should be made. A very thorough local examination ought to show the cause of the painful exacerbation, and it will often be found that there is a retention of secretion from the interposition of some mechanical obstruction, or an abscess has formed in the ear or its neighborhood. In case of a localized swelling in the meatus, a differential diagnosis should be made between a simple furuncle, which often occurs in the course of an otorrhœa as the result of maceration and irritation of the skin by the secretion, and a gravitation of pus or inflammatory irritation from the deeper parts of the ear, which, however, is more common in adults than in children, owing to the existence of larger cavities above and behind the

meatus. Of whatever nature the abscess in the meatus is, however, so soon as it produces a great narrowing of the canal, and thus hinders the exit of the pus from the deeper parts, no time should be lost in opening it with a narrow bistoury.

In children, inflammations of that part of the petrous bone which lies behind the auricle often occur; but, as this part before puberty is but slightly developed, it does not bear the name of mastoid process. Such inflammations usually arise from collections of pus or from the formation of granulations in the antrum mastoideum which is in open communication with the tympanum, but lies above and behind that cavity, and separated from the skin behind the upper part of the auricle only by a very thin lamella of bone. These inflammations are distinguished by decided local pain, increased by pressure; this is followed by redness of the skin and œdematous swelling, and the disease runs it course with febrile reaction, and more or less involvement of the general system. The swelling is characterized in its very beginning by a marked asymmetrical prominence of the auricle, which will be readily overlooked in a simple side-view of the head. In such cases leeches are usually of no further value, and may even increase the discomfort from the greater swelling produced in the skin and glands by the bites. For the less urgent cases, frequent painting with the strong tincture of iodine and the continuous application of a small ice-bag behind the ear may be tried, but if the symptoms do not diminish, and especially if the temperature rises decidedly, an incision should be made as soon as possible through the soft tissues down to the bone, at a distance of $\frac{1}{2}$–1 cm. behind the insertion of the auricle; this should be continued from the insertion of the sterno-cleido-mastoid upwards at least a centimetre above a line which would pass through the upper edge of the meatus. The infiltration of the skin and of the lymph-glands, which are often

involved in the incision, is frequently so great as to cause surprise at the depth at which the periosteum is reached, and to complete the incision of the periosteum, a second cut may be necessary. The bleeding may be profuse, but this is rather advantageous than otherwise. Should a branch of the arteria auricularis posterior bleed obstinately, it may be checked by continuous digital compression, or by torsion with forceps. Great relief usually follows immediately, and often there is a direct lowering of the temperature even in those cases where no pus is evacuated, and therefore, as Wilde, of Dublin, first recommended,[1] it is by no means advisable to delay the incision till fluctuation or visible abscess has formed behind the auricle.

This Wilde's incision must be regarded chiefly as an antiphlogistic remedy, acting thus on account of the connection between the external blood-vessels and those within the bone and cranium. Sometimes by the incision a flat purulent collection beneath the periosteum is evacuated, and the recognition of such a collection by the finger is much more difficult than when it lies between the skin and periosteum. After incising such a subperiosteal abscess, the bone may be found softened, roughened, or even with a fistula through it, and the best course then is to remove the diseased spot immediately with a sharp spoon or the hand gouge and enlarge the fistulous opening, when it will generally be found that the antrum mastoideum has been opened. In some cases, the bone which has been laid bare by Wilde's incision only becomes carious or fistulous after a considerable length of time, and the removal of the bone is then for the first time indicated. If the antrum is not opened by removal of the diseased bone, the thin osseous plate separating it should be perforated and that cavity opened, as the retention of pus

[1] Wilde, "Practical Observations on Aural Surgery." London, 1853, p. 237. Deutsche Uebersetzung von v. Haselberg. Göttingen, 1855, p. 278.

or the development of granulations within it is, as a rule, the source of the inflammation. In some cases, scale-like sequestra are found directly beneath the skin, and can be readily removed after the incision of the integument.[1]

In childhood, it is often observed that very serious illnesses, accompanied by high fever, dulness of intellect, and often by unrecognizable brain symptoms, are suddenly relieved by a spontaneous rupture of the bone, just behind the ear on the borders of the hair, and by the free evacuation of pus. Such unexpected occurrences sometimes clear up what has previously been a doubtful disease, neither the physician nor the parents having thought of an ear-affection, much less having diagnosticated it with certainty. There is the more reason, therefore, why we should lend our aid in producing a similarly favorable result in those cases where, in the course of an acute or chronic otitis, the existence of a purulent collection or of a sequestrum within the petrous bone can be assumed with all probability, or even with absolute certainty, to be the cause of the existing symptoms. Chills, a continuous high temperature, severe pain in and behind the ear which increases upon pressure or percussion and extends up over the head and usually associated with inflammatory œdematous swelling of the post-aural region, all point to such a condition. In some cases, where a marked disease of the external bony table does not exist, it may be advisable to be content at first with the Wilde's incision, and then to wait some days to see if improvement does not follow without any further operation. A similar incision of the

[1] I myself possess two almost symmetrical flat sequestra, consisting of the outer surfaces of the two petrous bones, corresponding to what would later become the mastoid processes; they were taken from a boy six years old. Each is 18 mm. long by 10 mm. wide, and in connection with each is a mass of spongy bone. They were readily removed by incision behind the auricle, and the suppuration immediately much reduced.

skin must naturally precede the artificial perforation of the antrum mastoideum.[1]

The cortical substance of the petrous bone is so thin in small children that a strong pressure with the knife is often sufficient to open the cavity, but it is much better to make a large opening into the antrum mastoideum by means of a sharp spoon, a gouge, or Luër's gouge-forceps. Without such a free opening, it will be difficult to thoroughly evacuate the collections of friable and caseous pus which are contained in the cavity, and to wash out the suppurating ear from the opening with a warm $\frac{3}{4}\%$ solution of salt, to which a little carbolic acid has been added. The older the child, and the longer the purulent inflammation has continued, the thicker the corticalis will be.[2] The antrum mastoideum lies above and behind the upper edge of the external meatus. After incision of the soft parts and pushing aside the periosteum, the perforating instrument should be applied to this spot, about one centimetre behind the insertion of the auricle, and should be worked inwards and forwards, parallel with the meatus. Upwards and backwards the dura mater would be encountered, and care should be taken, therefore, to direct the chisel rather downwards, and even too much forwards than the opposite, for the worst that could then occur would be an opening beneath the floor of the antrum, or into the meatus in the neighborhood of the membrana tympani, and as soon as the error was discovered, it could be corrected without injury. The artificial opening should

[1] The whole history of surgical opening of the mastoid process is given in the author's Lehrbuch, p. 449. How frequently this operation is necessary is shown in Schwartze's "Casuistik zur chirurgischen Eröffnung des Warzenfortsatzes" (Archiv für Ohrenheilkunde). Of the forty-four operations by Schwartze, sixteen were in patients less than fifteen years old, viz., vol. x., pp. 25, 35, 36, 179, 182, 197, 203; vol. xi., pp. 138, 144, 153; vol. xii., pp. 113, 114, 121, 124, 135, 138.

[2] In one child, aged thirteen, who had suffered from suppuration for four years, Schwartze found the corticalis 2 cm. thick.

be large enough to give exit not only to the caseous pus and the onion-like layers of epidermis which are often found in old inflammations, but also to the passage of possible sequestra. The perforation of the bone should be kept open for a considerable time, and cleansed with the greatest care from masses of pus, loosened bits of bone, and granulations. As a rule, the formation of such a counter-opening, and the thorough washing out of the ear with disinfecting solutions which is thereby made possible, has such a favorable influence on the suppuration that it rapidly diminishes, even when it has been of long continuance, and assumes a benign character or ceases entirely. The fistula then closes gradually, and there only remains a funnel-shaped, retracted cicatrix above and behind the ear.

Extensive necroses of the petrous bone occur but rarely when we remember the frequency of suppurations of the ear, chiefly for the reason that the bone is very rich in blood-vessels which enter it from both the external and internal surfaces; in children, however, such results from chronic suppuration are much more common than in adults. Sequestra, often of considerable size, usually show themselves in the meatus, and consist either of a part of the tympanic wall, or of the drum-membrane-ring (pars tympanica), or of a portion of the wall of the meatus with some of the neighboring spongiosa, or of the osseous labyrinth which has become isolated and been thrown off. The loss of the labyrinth is caused, wholly or in part, by a necrotic process where the suppuration has extended through one of the fenestræ to the periosteum of the labyrinth, or where a circumscribed inflammation has formed around the osseous labyrinth.[1]

[1] Böters describes in his Dissertation "Ueber Nekrose des Gehörlabyrinthes" (Halle, 1875), 16 such cases, of which 6 or 37% were children. See further on this subject, author in Virchow's Archiv, xvii., p. 47; Toynbee in Arch. f. Ohrenheilkunde, i., p. 112 und 158; Schwartze, ix., p. 238; Lucae, x., p. 236;

The osseous labyrinth is well known to be developed independently of the rest of the petrous bone, and in the fœtus is surrounded by a perfect osseous capsule while all the rest of the tissue about it is still cartilaginous, and in small children the osseous labyrinth can be readily separated from the surrounding bone with a pen-knife.

The incision behind the ear or the opening of the large cells of the antrum often enable us also to remove sequestra which have originated in the deeper parts or which consist of a lamella of the external corticalis. It is remarkable that patients after very extensive necroses not only escape with life, but the whole suppuration usually ceases soon after their removal.

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also Gruber, Lehrbuch, p. 542 (a case of loss of both cochleæ of a child during life).

III. FOREIGN BODIES IN THE EAR.

In children, small foreign bodies frequently get into the meatus, thrust or thrown in either by the children themselves or by their companions while at play. Anything like a complete enumeration of such foreign bodies is impossible, but among the most common of them are peas, coffee-beans, cherry and other seeds, or parts of plants, pebbles, beads, kernels of corn, metallic or pearl buttons, teeth, bits of bread, wool and paper, pieces of lead- and slate-pencil or pen handles, etc. Immediately parents and teachers become greatly frightened, and a physician is called, who, with a loss of time and the application of instruments, removes the body, or, it may be, thrusts it further in. Where the extraction is successful there often enough is left more or less injury to the ear, which results in suppuration, and many cases can be found in the literature where children have died from the diseases which have been described in the preceding chapter as resulting from aural suppuration, the result of a foreign body being removed by operation or left in the ear.

It is perfectly certain that, in the vast majority of such cases, the worst effects are produced, not by the original substance introduced, but by the steel foreign body with which the ear has been searched, and, after the use of which, as a rule, the child first begins to complain of pain in the ear and of other symptoms.

An examination of the above list of the more common

foreign bodies shows that most of them are round or, at least not on all sides, sharp-edged or pointed; neither do they consist of substances soluble in the meatus, which might set up a chronic irritation, macerate the skin, or produce decomposition. The fact that a body can be put into the meatus is by no means proof against the possibility and even probability that it may also fall out, especially if the application of the laws of gravity are applied. The possibility of its spontaneously falling out is only removed when the substance increases in size or becomes impacted in some way. The latter may sometimes occur in a certain degree from an abundant adhesive cerumen on the walls of the meatus. An increase in the volume of the body would only occur in certain vegetable substances after a considerable time, and then only when they met an abundant fluid secretion in the ear.

From an unprejudiced consideration of the character of the foreign body and of the anatomical relations of the meatus, in which it lies, the rule for most cases certainly is that no immediate danger threatens, even if the body remains for a long time; and this most valuable a priori reasoning in regard to foreign bodies in the ear can be fully supported from the literature of the subject.[1] The worst to be feared is that the meatus will become stopped up, and the hearing consequently diminished, either from the body itself closing the meatus or from a gradual accumulation of cerumen about it.

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[1] In Linke's Handbuch der Ohrenheilkunde (Vol. ii., Leipzig, 1845, p. 569), cases are reported where a pea remained in the ear in one case seven years, in another, ten years; a tooth remained ten years, a cherry-stone fifteen years, and a glass bead twenty years, without injurious result. In Rau's Lehrbuch (Berlin, 1856, p. 366), a case is reported of a coral bead remaining in the ear for forty-five years. In the Preussische Vereinszeitung, 1862, No. 25, there is a case of a carious tooth lying in the ear for forty years without producing the least disturbance; and in Allgemeine Wiener Med. Zeitung, 1862, No. 31, another, where a cylindrical bit of graphite, four and one-half lines long and three lines thick, was in the ear eleven years without making its presence known.

In all simple, uncomplicated cases, and especially recent ones, the best course is not to touch the body itself, but, laying the child upon the affected side, with the head downwards, as, for instance, hanging over the edge of a sofa, to give the head slight blows from above downwards. Small, flat, unadhesive, and unimpacted bodies can, in very many cases, by such means be again brought through the orifice of the meatus. Sometimes the bodies will be found the next morning in the bed, if that is examined. That many foreign bodies fall out of the ear of themselves is shown from the fact that the meatus of children brought to the physician "on account of a foreign body in the ear" is often found free, although no efforts at extraction have been made, or, if made, have shown no visible result.

The next most useful course is syringing with warm water. Any cerumen which was narrowing the space and holding the body will thus be removed, and the water getting behind the body may wash it outward. At least, after such syringing, the side-position and downward movements of the head may be crowned with better success. The only proper contra-indication for this syringing is when we are dealing with large parts of plants, which swell readily, and where we have to fear that a very slight increase in their size would bring them in contact with the walls of the meatus, and so impact them.

In cases in which small beetles, fleas, bugs, and similar animals get into the ear, and cause pain by their movements, the best course is to drop in warm oil, or to blow tobacco smoke into the ear, and then to syringe with warm water. By such means the insect either beats a retreat or is rapidly killed; at least, it is brought out living or dead.

In many cases, a slight raising of the foreign body from the wall of the meatus will make a space through which water from the syringe can pass behind, and so force it out. A flat, sufficiently long, and blunt lever, such as can

easily be made of wood with the penknife, is adapted for such manipulations, or a delicate probe, without a bulb-point, the point of which has been curved or even bent at an angle, can also be used. If the child is intelligent and quiet enough, attempts may be made with such instruments thrust between the wall of the meatus and the foreign body to fix it from behind, and thrust it outwards either the entire distance or partially, and then to complete the removal by shaking the head or by syringing.

A very useful method in some cases is to pass a wire-loop, like that upon a Wilde's polypus snare, along the side of the body, and fixing it in the loop, to draw it out. This method is particularly good, because the instrument does not injure the neighboring parts, and has the advantage that it can be passed through a small space. The attachment of an adhesive substance to the foreign body, and allowing it to dry, thus forming a handle by which the offending substance can be withdrawn, is a perfectly harmless method, and frequently successful. In addition, children can be brought to submit to it readily.[1]

As a conditio sine qua non to the use of every instrument, even the simplest, in the meatus, absolute immobility of the child must be assured, which can never be depended upon without anæsthesia, if any attempts at

[1] This adhesive method has been several times recommended. Linke reports (Vol. ii., 1845, p. 585) that a Boston mechanician, Eli Blake, removed a pebble from the meatus by applying a pencil of cotton-wool, moistened with shellac, and allowing it to remain in contact with the stone for twenty-four hours. For favoring evaporation, warm air was blown in upon it. Although the foreign body was firmly inclosed in the swollen tissues, it was withdrawn in this method. In Philip von Walther's System der Chirurgie (Vol. ii., Freiburg, 1847, p. 292), the application of an adhesive and rapidly drying substance, like copal-varnish, is recommended. Engel (Med. Centralzeitung, 1851, No. 63) advises the use of a cloth dipped in thick, freshly-prepared, warm glue, to be placed against the foreign body, and left for several hours to dry. Loewenberg (Berliner klin. Wochenschrift, 1872, No. 9) also recommends glue for moistening the point of a mass of charpie; and Zaufal (Archiv für Ohrenheilkunde, vii., 1873, p. 238), from experiments on the body, pronounces this method effectual.

extraction have already been made; and, again, the physician should be familiar with the minute anatomy of the ear, at least so far as to be aware that the obliquely-placed drum-membrane lies nearest the orifice of the meatus in its upper posterior part; finally, the meatus should be thoroughly illuminated, so that the foreign body, with its surroundings, are distinctly visible. If any one of these precautions cannot be taken, or if the physician has had too little practice in examining the ear, the only proper and advisable thing is to abstain entirely from the use of instruments; otherwise, the present unimportant condition of the patient may be changed into an unfavorable or even serious one from the foreign body being forced farther inwards or from an injury to the meatus or drum-membrane. The less adapted the instrument is for the ear, or the more complicated the surgical apparatus used, the more likely will a damnum permanens et irreparabile be done to the little patient, from a neglect of some of the precautions which are necessary even in the simplest manipulations of this organ.

From bruises and tears of the skin of the meatus, as will sometimes occur from such operations, great swelling of the canal and an intense otitis externa is produced, so that the foreign body, which was before relatively loose, becomes impacted, and then acts as a further irritation to the already inflamed and exposed cutaneous, cartilaginous, and osseous tissues, although to the healthy skin it was perfectly harmless and indifferent. In such cases, as a rule, there is rapidly developed an extremely painful inflammation, accompanied by a bloody purulent secretion and a rapid growth of granulations in the meatus. It sometimes happens that these granulations push the foreign body before them towards the orifice, so that it can be readily removed or it falls out of itself. Possibly it has been out of the ear for a long time; at any rate, we have to deal no longer with it, but with a more or less intense trau-

matic otitis, which not infrequently produces febrile disturbance and phlegmonous abscesses in the meatus and its neighborhood, and sometimes ends with necrosis of a portion of the ear-passage or of the pars tympanica.

Remembering the previous remarks on arrests of ossification in the anterior lower wall of the meatus, it is possible to imagine that such defects might be of practical importance when children from four to six years of age were subjected to these mischances and operations. Small and, especially, heavy bodies, like kernels of corn, might sink into these spaces, and become impacted, or it is also very possible that such substances might be pressed through these defective spots, or even through the thin lamella of bone which forms later, especially as these spots are directly opposite the force used by the operator from above and from without. The fact that, in little children afflicted with aural inflammation, diseases of the region just in the front of the ear, and especially of the neighborhood of the lower jaw, are much more common than in adults is certainly connected with this anatomical peculiarity of the child's meatus.

Even if the drum-membrane is not injured in the original attempts to seize the foreign body, it will certainly be involved in any extended otitis externa, and, from the suppurative process, will sometimes suffer a loss of substance by which the purulent inflammation will extend to the tympanum, and the dangers to the health of the child, in addition to the certain injury of the hearing, will be very much increased. With energetic, or, to speak more correctly, imprudent manipulations, the instruments come in contact with the drum-membrane, and a hole or rough tear is produced in it, or even the foreign body lying in the meatus is driven into the tympanum. Even from this spot it may be forced out by the pus or by the granulations springing from the walls of that cavity, although, under such circumstances, there is usually not much drum-mem-

brane left to hold it back. In some cases, the hammer or the anvil may be lost, either directly from the operative interference and the resulting bleeding, or later from the action of the inflammation and suppuration. As we have already shown, from such extractions and attempts at extraction not infrequently the life is sacrificed.

Let it be distinctly understood that the seizing of a foreign body between the branches of any instrument always presupposes a sufficiently free space between the body and the two walls of the meatus. If this space is wanting, the skin of the meatus must necessarily be bruised; the instrument is also apt to slip off any smooth body, which is then driven further in, and this not only makes it more difficult to reach, but is liable to force it against the drum-membrane. Such instruments can only be of use in the most favorable cases, but in these cases a much more simple and perfectly harmless method is also sufficient—namely, a stream of water, which, by getting behind the body through the intermediate spaces, can readily float it out. Syringing is also effectual if the body is separated from the wall at only one spot—a condition unfavorable for the application of the majority of instruments in common use, and which, at the most, requires a thin flat lever or, perhaps, a wire-loop.

The physician is often led to active interference from an erroneous supposition that the existing inflammation and severe pain of which the patient complains is due to the presence of the foreign body in the ear, when it is simply a traumatic inflammation, the result of previous attempts at removal. Instead of accepting the warning, he misinterprets the existing symptoms, and considers it his duty to make renewed attempts, without remembering that in this way he may only double the injury, especially if he operates without an accurate knowledge of the locality, and without illumination of the meatus, with forceps not adapted to the ear; and, in addition to this, upon a child

screaming and opposing with all its might a repetition of its previons agonies. Would that the physician would oftener remember how perfectly harmless the pea or the bead is in the ear compared with the foreign body of steel with which he bores around in the meatus. We cannot forbear mentioning that such attempts at extraction are sometimes undertaken on the simple statement of the parents or child when there is no foreign body in the ear. Cases have even been reported where, for instance, a button lay quiet and forgotten in one meatus, while an operation for its removal was performed upon the other ear. The venerable Heister once said "Chirurgus mente prius et oculo agat, quam manu armata." These words are too frequently applicable to our present subject, where sins both of commission and of omission are common.

If we have to deal with a case in which the ear has been injured from the search for a foreign body, and where, as the result of the mechanical irritation, an inflammation has supervened, the only proper course to pursue is to calm the excited parents, leave the child and the foreign body in peace, and treat the traumatic otitis simply; first, however, attempting to see whether the little sufferer will permit syringing with warm water. The irritation and swelling of the tissues render the examination of the ear and the introduction of any instrument, and sometimes even of the speculum, difficult. Not infrequently, in such cases, it is at first impossible to say whether the foreign body is in the ear or not.

In a certain proportion of cases, however, from the seriousness of the symptoms, the immediate removal of the foreign body is the only thing to be attempted. The best course then is not to attempt to seize the foreign body through the narrow orifice of the meatus, but rather to make a broad and direct passage to it by partially displacing the auricle. By this means the impacted body may be reached more certainly, and without injury to the neigh-

boring parts. Paulus Æginetus (660), and others of the old physicians, recommended in such cases a semilunar incision behind the auricle, in order to reach the depths of the ear more readily. With children, it might be more advantageous to separate the auricle above rather than behind, as the arteria auricularis posterior has its course in the latter position. At this age, when the osseous meatus is still in process of development, the squamous portion of the temporal bone above the orifice of the meatus forms an inclined plane, which runs as far as the drum-membrane. After separating the auricle, and displacing it downwards, a bent lever, or a Wilde's polypus snare, or possibly even a pair of forceps can be passed to the deepest parts, and either seize the foreign body directly or force it forwards from behind.

At any rate, such an operation is much more likely to be effectual, and its results can be better depended upon; and the simple incision may be expected to heal much more quickly and surely than the crushing and tearing wounds of the meatus and of the drum-membrane, which can scarcely be avoided with the common methods of operating from the orifice of the meatus.

Although we must in general warn against the danger of laying too much stress upon foreign bodies in the ear; on the other hand, it should not be forgotten that spasmodic symptoms, particularly in the nervus vagus, extended neuroses, and even epilepsy may arise from a continuous mechanical irritation of the nerves of the ear. Fr. Arnold[1] reports the case of a girl who suffered for a long time from a severe cough and expectoration, frequent vomiting, and increasing emaciation; examination showed a bean in each ear, the withdrawal of which was accompanied by severe coughing, violent vomiting, and frequent sneezing: the symptoms ceased immediately, and the child

[1] Bemerkungen über den Bau des Hirns und Rückenmarks. Zürich, 1838, p. 170.

made a perfect recovery. A much more important case, and often quoted, is that of Fabricius Hildanus;[1] a girl who in her tenth year had put a glass ball, the size of a pea, into her left ear, the removal of which had been often attempted in vain, began to suffer later from unilateral headache, an intermittent anæsthesia of the entire left side of the body, accompanied by severe pain, followed in the course of some years by epileptic convulsions and atrophy of the left arm. As earache was no longer present, the ear was not thought of till the patient came under the treatment of Fabricius in her eighteenth year, who learned accidentally of the bead in the ear; he removed it, and thus freed the patient of all her symptoms.

It should always be borne in mind, in any case of extended neuroses of uncertain origin, and especially in epilepsy, that the ear is one of the parts requiring attention and examination.

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[1] Opera quæ exstant omnia. Francof., 1646. Centuria prima. Obs. iv., p. 15.

IV. THE DISEASES OF THE INNER EAR OR LABYRINTH.

UNDER the term "nervous deafness" are usually included all those forms of diminution or annihilation of the function of hearing which arise from pathological processes in the parts lying beyond the tympanum, either in the labyrinth itself, in the auditory nerve, either within or without the petrous bone, or, thirdly, in the region of brain-substance from which the fibres of the nervus acusticus arise. In this place, we have to deal chiefly with the diseases localized in the labyrinth, but we shall be obliged to touch upon some of the intracranial and cerebral processes so far as they are liable to alter or destroy the hearing.

Only a very few pathological conditions have been as yet anatomically recognized and accurately determined in the cavities and tissues of the labyrinth. Aside from the determination of the fact that affections of the nervous or sound-perceptive apparatus are by far less common than those of the sound-conducting, peripheral parts, the tissues have as yet received very little attention from pathological anatomists, which is explained but partially by the relatively vast extent of the field. Some of the appearances considered as pathological may be in reality normal, such, for instance, as the large or small amount of the otolithes for which we, as yet, have no normal standard, or, again, the often described black pigment which, according to the books on histology, is found in various parts of

the labyrinth in almost every healthy ear. Deiters[1] has said, "how very common it is, even in otherwise healthy individuals, that Corti's organ with its appendages has undergone pathological changes, especially fatty degeneration, and how rare it is in man to get a perfectly normal example for examination."

The largest number of observations have been in regard to malformations of the inner ear, because these are more commonly, although not constantly, associated with deformities of the external parts. A thorough review of the reports upon these malformations will be found in Schwartze's Pathological Anatomy of the Ear. The entire labyrinth may be wanting, or it may be but partially developed; in the latter case, some of the parts, most commonly the semicircular canals, are absent, or they exist only in a rudimentary form, as for instance the cochlea possesses fewer spirals than normal, or the whole labyrinth forms a single cavity in the shape of a curved canal without communication with the tympanum. Variations in the form and size of certain parts are very common, but are, according to Meckel and Claudius, always the same on the two sides. The possibility of a malformation or arrest of development being confined to the inner ear is explained by the development of the ear; the labyrinth is formed from its own labyrinth-vesicle in the region of the cerebellum, while the middle ear and the meatus are formed from the first branchial fissure, and the ossicles from the two first branchial arches. It is also established that the ossification of the labyrinth is finished much earlier than that of the external portions of the petrous bone. In only extremely rare cases has a congenital absence of the auditory nerve been observed in connection with defects in the labyrinth.

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[1] Untersuchungen über die Lamina spiralis membranacea. Bonn, 1860, p. 11.

In regard to the diminished or increased amount of blood in the tissues of the labyrinth which has been occasionally observed, it is difficult to estimate how far this is pathological: the redness found in the interior of the labyrinth is more rarely dependent upon local causes than upon the large or small amount of red corpuscles in the blood of the individual, and is also apt to go hand in hand with anæmia or hyperæmia of the brain. And even if it should be decided that there always exists a free anastomosis between the vessels of the inner and middle ears, which almost all anatomists still deny,[1] nevertheless the fact that the labyrinth receives its nourishment chiefly from the same sources as the brain would remain. Its chief vessel, the arteria auditiva interna, which enters the meatus internus with the acoustic nerve, is derived from the brain and is in the circuit of the subclavian, while the vessels of the external and middle ears are derived from the external surface and are in the circuit of the carotid: it originates either directly from the basilaris or from the arteria cerebelli inferior, and is a vessel of the brain, in that it closely resembles the other brain arteries both in the character of its walls and in the amount of blood it contains. The venæ auditivæ internæ, which also run through the meatus internus, empty into the sinuses of the dura mater, and therefore venous hyperæmia must occur in the labyrinth whenever a decided passive congestion takes place in the blood-current of the brain or its membranes. This view, that the nutrition and blood-

[1] The majority of anatomists hold, and the experimental injections which have been tried show, that the labyrinthine vessels form a wholly separate system from that supplying the peripheral parts of the ear, and are not in direct connection with the other vessels of the temporal bone. Some observers are reported to have seen single small veins and arteries of the tympanum which passed through the membranes of the round or oval fenestræ into the labyrinth, and Politzer asserts lately (Archiv für Ohrenheilkunde, 1876, xi., p. 237) that he is absolutely convinced, from sections made through the promontory, that there exists a direct connection between the vessels of the tympanum and those of the labyrinth.

current of the membranous labyrinth is principally influenced by intracranial processes, corresponds with the anatomical experience of Schwartze,[1] "that even in the very highest degrees of inflammation in the tympanum it is only exceptionally that a simultaneous hyperæmia is met in the labyrinth." Hyperæmia of the labyrinth is, on the other hand, observed with hyperæmia and passive congestion within the skull, with some of the general febrile diseases, such as typhus and acute tuberculosis, and also with disturbances of the circulation originating in the heart or lungs, or produced by pressure upon the veins of the neck or upon the brain sinuses. Under such circumstances, ecchymoses or even hæmorrhages may occur in the membranous tissues of the labyrinth.

In regard to the existence of purulent inflammation within the labyrinthine cavities, all of the autopsies where this condition was found to exist show that either pus was also present in the tympanum, or that there was purulent infiltration in the brain-membranes, so that the question whether there is such a thing as a primary and independent labyrinthine suppuration, a genuine otitis purulenta intima, must be regarded, from an anatomical stand-point, as still open. "It is very rarely that patients die with acute labyrinthine inflammation, and therefore it can only be through an accident that the anatomical doubt in regard to this disease can be cleared up."[2] As we have already said, in children where the

[1] L. c., p. 180.

[2] Schwartze, p. 120. The case which was lately published by Schwartze (Archiv für Ohrenheilkunde, xiii., p. 112) as "primary acute purulent inflammation of the labyrinth" does not seem to me absolutely conclusive, because with the labyrinthine disease there was an extended meningitis over both the convexity and the base of the brain, which we cannot assert with certainty was a later process. Again, the patient heard too well in that ear only six days before death, for us certainly to attribute the symptoms of vertigo, etc., simply to the pus in the labyrinth. If the disease had begun with a sudden deafness, it might have been referred to a purulent labyrinthine inflammation.

tympanum is filled with pus, a very few will also show pus in the labyrinth. A lower degree of inflammation in the form of a small-cell-infiltration of the membranous labyrinth was found by Moos associated with otitis media purulenta in some cases after typhus, scarlatina, and variola.[1] We have already called attention to the fact that with chronic suppuration of the middle ear the inflammation not infrequently extends to the labyrinthine cavities either through a carious fistula or from a rupture through the membranes of the fenestræ.

The deafness with meningitis cerebro-spinalis epidemica should be considered here, as occasionally pus is, in these cases, found in the labyrinth. This disease, cerebro-spinal meningitis, finds most of its victims among children, and is the cause of innumerable cases of deaf-mutism, as has been shown by Emminghaus in the second volume of Gerhardt's Handbuch der Kinderkrankheiten. Ziemssen[2] himself saw eight cases of total deafness result from forty-two cases of the disease, nearly twenty per cent. Usually in the earlier course of the disease, there is complaint of roaring and ringing in the ears, followed sometimes by ear-ache, hallucinations of hearing, and soon after by dulness of hearing. This passes nearly always into bilateral and permanent complete deafness; but in exceptional cases, the symptoms pass off wholly or partially in the course of a few months; equally exceptionally it happens that only one ear is affected. Usually for months, or even longer, a staggering gait is left.

Unfortunately we have but few accurate reports of the appearances of the ear in such cases of deafness produced by cerebro-spinal meningitis. In some of these reports, only purulent inflammation of the tympanum was found, and the question might well be raised in several of these,

[1] Archives of Ophth. and Otology, v., p. 221.

[2] "Meningitis cerebrospinalis epidemica," in Handbuch der speciellen Pathologie und Therapie, ii., 2, 1874, p. 675 und 680. Amer. Translation.

when the tympanic inflammation appeared very late (in Ziemssen's case on the twenty-fifth day, with a rupture of the drum-membrane on the thirty-sixth day), whether this purulent inflammation was not the result of the careless applications of ice. Merkel found in one case of bilateral absolute deafness that the right ear showed no changes, while in the left ear the tympanum was unaffected, but the membranous semicircular canals were much swollen and spongy, and in the anterior canal was a gelatinous purulent mass. In two cases, Arn. Heller[1] found a small amount of pus in the tympanum and the cochlea, vestibule, and semicircular canals in an advanced stage of purulent inflammation. The important question now arises, whether this form of otitis intima purulenta is an independent process developing at the same time as the inflammation of the meninges of the brain and spinal cord, or whether it must be regarded as an extension of the purulent inflammation from the meninges along the neurilemma of the acusticus into the labyrinth. Heller, from the appearance of the nervus acusticus, which in both of his cases he found infiltrated with pus, and also from experimental injections with a solution of carmine through the porus acusticus, favors the latter view, but, on the other hand, acknowledges that the ecchymoses found in the labyrinthine cavities point rather to disturbances of circulation in the internal ear and to a primary inflammation at that point as the cause of the pus. In a case dissected by Lucae,[2] slight injection of the tympanic mucous membrane with a purulent inflammation of both labyrinths was found, and considered by him as a genuine inflammation, and not a simple extension of the pus from the base of the brain. Unfortunately the three cases where the

[1] "Zur anatomischen Begründung der Gehörstörungen bei Meningitis cerebro-spinalis." Deutsches Archiv für klin. Medizin, iii., 1867, p. 482.

[2] "Eiterige Entzündung des inneren Ohres bei Meningitis cerebro-spinalis." Archiv für Ohrenheilkunde, v., 1870, p. 188.

ear was thoroughly examined were adults and not children. In the majority of cases of cerebro-spinal meningitis, the deafness has been referred to the extensive changes in the meninges and in the fourth ventricle, which latter has been often found to be full of pus.

In continuation of our description of the anatomical changes which have been recognized up to this time in the inner ear, a small number of dissections have shown the organized results of previous inflammatory processes in the labyrinth, such as thickenings and atrophies, small growths and degeneration, detritus and calcification; but in these cases the ages of the subjects are not given. As a rule, the pathological changes were simply accidental discoveries, the history of the cases not being known, and particularly nothing accurate being given in regard to the hearing power. On the other hand, dissection has failed to recognize changes in the tissues of certain cases where the clinical history would lead us to seek for the cause of rapid or sudden annihilation of the hearing in the sound-perception or nervous apparatus. Acute pathological processes within the tympanum run their course, so far as we know, only with decided and objectively recognizable appearances of inflammation and exudation; they also injure the hearing only to a certain degree; but unfortunately an accurate determination of the boundary-line has never been established beyond which we can assert that a deafness is to be referred to a disease of the acoustic nerve in the labyrinth or to a central lesion, and on this side of which exudative processes in the tympanum or disorganization at the round or oval fenestræ are sufficient to account for the loss of hearing.

A still greater difficulty is presented in the differential diagnosis between acute meningitic and other intracranial processes on the one hand, and purulent processes within the labyrinth on the other hand, as a very rapid diminution or complete loss of the hearing power is common in

both varieties, and a large number of similar appearances are found in each. Cases are not infrequently observed of children who had heard perfectly well before, or at least, judging from the distinctness of their speech, could not have heard badly, from a sudden cold, or even without this, being seized with violent vomiting which may continue for several days. They have fever and more or less marked symptoms of pain and increased temperature in the head and sometimes an approach to opisthotonos. With this febrile condition the consciousness is sometimes only dimmed, sometimes entirely lost for a longer or shorter time, and there are always marked cerebral symptoms, sometimes of a depressed character, sometimes of an excited delirium. When the child begins to come to itself after from one to ten days, a bilateral, usually total deafness remains, accompanied frequently by subjective noises, such as of music or bells. The child usually recovers very rapidly from the brain symptoms, but there is often a slight recurrence of fever for a few days. For weeks and even months a staggering gait or a tendency to fall forwards remains, which the patient is unable to define as distinct vertigo with movement of objects before the eyes; every symptom of paralysis is wanting in these cases. In very few cases does the total deafness improve; it usually remains unchanged, and those children who had not thoroughly learned to talk become deaf-mutes, and those who were older and had already learned to read, require to be brought up with the greatest care or they will lose their speech.

What shall be thought of this disease which is by no means rare and of which we have not a single dissection? What and where is the pathological process?[1] Let us see,

[1] Voltolini who first described the disease in the first number of the Monatschrift für Ohrenheilkunde (October, 1867) under the title, "The acute inflammation of the membranous labyrinth, usually mistaken for meningitis," thought that "from the symptoms alone a diagnosis could be made with certainty."

to begin with, what observations on similar cases in adults are at hand.

In 1861, Menière, a very accomplished aurist in Paris, called attention to a disease beginning with vomiting, dizziness, violent subjective noises and fainting, which produced a permanent total or very great deafness and a long-continued uncertainty in walking and standing.[1] This disease, resembling an apoplectic congestion of the brain, is considered by Menière to be probably a pathological process in the labyrinth, more especially in the semicircular canals; he was led to this conclusion by the dissection of such a case which died on the fifth day, and in which the brain, spinal cord, and ear were found to be healthy, with the exception of the semicircular canals, which were filled with a red plastic lymph. His theory was supported by the well-known experiments of Fleurens, who had observed that destruction of the semicircular canals in pigeons and rabbits was followed by a loss of the sense of equilibrium in walking and standing, accompanied by frequent falling. Diseases of the semicircular canals, which contain fibres of the auditory nerve only in their ampullæ, is wholly incapable, however, of producing the total deafness in the disease we are considering. On the other hand, a number of observations have proven conclusively that injury of the labyrinth in man will produce the symptoms described by Menière.[2] It should also be remembered that similar symptoms (at least of a lesser degree and temporary) may

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"There is no doubt that in this disease the labyrinth is destroyed," etc. (Vide Translation of the article in Boston Med. and Surg. Journal, June 25th, 1868). See also in regard to otitis intima sive labyrinthica, Voltolini, M. f. O. 1868, No. 6, and 1870, Nos. 7 and 8; also Reichel, in Berliner klin. Wochenschrift, 1870, No. 24.

[1] Gazette méd. de Paris, 1861, pp. 29, 55, 88, 239, 379 and 597. More thoroughly discussed in the text-books on otology, as in the author's, pp. 538–543, 6th edition.

[2] Politzer (Archiv für Ohrenheilkunde ii., p. 88), and Schwartze (idem, xii., p. 132).

also be produced by exudative processes in the tympanum, and even by the pressure of cerumen or of a column of cold water upon the drum-membrane. We should therefore do well, even in adults, not to speak of Menière's disease, which, being a labyrinthine affection, is inaccessible to every treatment, but rather to use the expression, Menière's symptoms, since they may be produced by peripheric diseases which on removal generally restore the hearing. Such diseases rarely affect both sides at once, but usually occur first in one ear and then, some years after, in the other.

With children also we should certainly be careful not to diagnosticate an affection deeper than the middle ear, simply from these Menière's symptoms, as with tympanic affections in childhood the accompanying fever and affection of the sensorium, which may increase to actual unconsciousness and delirium, render any decision on the hearing power uncertain. When, however, as in the above described disease, for weeks after the sensorium has become clear, the hearing is reduced to a minimum or completely annihilated, the diagnosis can only be an exudative process either in the labyrinth or within the skull; not only the febrile action during the disease, but the recurrence of an increased pulse and temperature after the acute stage has passed, often after intervals of several days, all point to a formation of pus.

Comparing the characteristics of the disease in question, by which children are made deaf with the symptoms given by Menière, with the well-recognized symptoms of meningitis cerebro-spinalis epidemica resulting in deafness, and the very great resemblance will be recognized by every unprejudiced mind. We find almost exactly similar symptoms, except that in the disease we are considering they are diminished in intensity and shortened in their duration, and on this account the children rarely die but, on the contrary, recover quite rapidly; the spinal symptoms and

the epidemic character are also wanting. Considering these differences, this disease is, I think, a circumscribed acute meningitis, that is a purulent inflammation of the meninges of the brain or of the dura mater limited to a small region.

This conclusion being granted, it seems to me most likely that there is an inflammation localized in the fourth ventricle or on its floor and lining membrane. In the filling of this cavity with pus, or in the purulent infiltration of its floor and its vascular lining, we must seek for the anatomical cause of the deafness remaining after epidemic cerebro-spinal meningitis in the cases in which the examination of the ear gives a negative result.[1] In that spot we shall find the explanation for the fact that the deafness in our disease is always bilateral.

This constant bilateral character of the deafness is, in

[1] When von Ziemssen (l. c., p. 681) says, "Often the floor of the fourth ventricle was macerated with pus and the nervi acusticus and facialis completely surrounded with purulent exudation without any disturbance in the hearing having been noticed during life," the inquiry suggests itself whether such a maceration was not a superficial one or a post-mortem change; for with a deep disorganization of the floor of the ventricle, from which both nerves arise, a normal conducting power in those nerves is inconsistent. To be sure, Ladame (Symptomatik und Diagnostik der Hirngeschwülste, Würzburg, 1865, p. 55) gives four cases of tumors of the fourth ventricle in which no deafness was noticed. In two of these cases, however, the tumors were unilateral, and could therefore have affected but one auditory nerve, and unilateral deafness may readily escape the attention of both physician and patient, but brain-tumors in general often run their course without any symptoms during life. The reason of this insidious course which Ladame himself gives (pp. 3–5), is largely due to the very slow growth of the tumors. The brain-substance may accommodate itself to a gradually increasing pressure which, if applied suddenly, would disturb the whole organism. It is a question whether we can imagine an intense purulent inflammation on the floor of the fourth ventricle or an acute hydrocephalus at that spot without a decided impairment of the function of the acusticus. In one case in which Förster found a cysticercus the size of a walnut in the fourth ventricle, the flatly pressed floor "showed no sign of the origin of the acusticus," but nothing could be learned about the hearing, as "the patient was brought into hospital with the symptoms of severe pressure on the brain and died before any accurate diagnosis could be made" (Würzburg med. Zeitschrift, iii., 1862, p. 192).

my opinion, the strongest argument against an inflammatory affection of the labyrinth, which would be much more probable if only one ear was affected, as frequently occurs in adults. The two tympanic cavities have a well-determined connection with each other in their lining membranes, which is a continuation of the pharyngeal mucous membrane, and the two tubes are influenced by the changes which take place in the naso-pharynx; on this account in severe diseases, like scarlet-fever, bilateral tympanic inflammations are very common. The two labyrinths, however, both in their blood-supply and in the formation of their tissues, are entirely independent of each other. Only a single part of the two labyrinths takes its origin from one common source, viz., the auditory nerve, which arises from the striæ acusticæ on both sides of the middle line of the floor of the fourth ventricle, a single undivided cavity. Any serious acute disorganization of this cavity, which lies on the posterior surface of the medulla oblongata, and especially purulent exudation and infiltration, must necessarily affect both of the acoustic nerves simultaneously, and would diminish or destroy the conduction from the central organ to the labyrinths. The other symptoms, the so-called Menière's symptoms, are readily explained from the irritation or tension to which the auditory nerves are subjected at their sensitive point of origin,[1] which irritation must certainly disturb the contents of the labyrinth.

The chief argument against this central or intracranial origin of the disease, as given by the advocates of a purulent otitis intima sive labyrinthica, is the absence of paretic

[1] Brown-Séquard considered Fleuren's symptoms the results of injury to the acusticus (Gazette hebdom., 1861, No. 4). Boettcher also considers them due, not to injury of the membranous labyrinth, but to other injuries accompanying the method of operating (Archiv für Ohrenheilkunde, ix., p. 1). Vertigo, disturbances of coördination, uncertain gait and deafness, are symptoms also accompanying tumors of the cerebellum which lies directly above the fourth ventricle (Obernier, Tumors of the Brain, Ziemssen's Cyclopædia, xi., 1, 1876, p. 232).

symptoms, especially in the nervus facialis, which always lies in the immediate neighborhood of the acusticus, and has its course in common with that nerve from the medulla oblongata into the petrous bone. A close investigation of the anatomical facts and of the reported cases would certainly have convinced these advocates that their facts rather favored than opposed the localization of the trouble beyond the labyrinth. The absence of paralysis would only show that the intense disease of the brain and nerve-substance must be certainly confined to a region from which no other nerves than the two acustici arise. In addition, von Ziemssen asserts that, so far as can be determined, central paralyses from epidemic cerebro-spinal meningitis are rare. With reference to the immunity of the facial nerve, it is well to remember the old names portio dura and portio mollis, formerly applied to the facialis and acusticus, when they were regarded as different branches of one and the same nerve. It is no wonder that the former has greater capacity for resisting injury than the latter. In all of the dissections of cases of deafness from meningitis, the difference between the condition of the two nerves, when infiltrated with pus, was marked and specially emphasized.[1] Von Ziemssen is explicit in stating that, in all of his patients where deafness resulted from

[1] Heller says, "the acoustic and facial nerves were surrounded with pus in the porus acusticus. Microscopic examination showed a great difference in the condition of the two nerves; between the fibres of the facial but few pus-cells were seen, while those of the acusticus and the ganglion-cells were thickly surrounded by them." In another case, "the acusticus was infiltrated with pus-cells; its vessels injected, and in some spots were ecchymoses between its fibres; its ganglion-cells were surrounded with pus; the nerve-fibres were in good condition. In the facialis, there were so few cells that it was doubtful whether they had not got there by accident. Both ears were alike."

Lucae reports the same, "both in the cochlear and vestibular branches of the acusticus, between their fibres, were pus-masses, pus-cells, and nucleated cells. The fibres appeared opaque, but were otherwise normal. The fibres of the facialis, on the contrary, were normal, and but few pus-cells were seen among them."

the meningitis, the functions of the facialis remained intact. The immunity of the facialis and the absolute isolation of the affection to the acusticus which, immediately after leaving the floor of the fourth ventricle, is associated with the facialis, is another argument in favor of the origin of the disease previous to the contact of the two nerves; i. e., at the place of origin of the auditory nerves in the fourth ventricle itself.

I am well aware how little has as yet been accomplished to confirm this hypothesis that the pathological product of the disease in question is to be sought at the common origin of the two auditory nerves. Moreover, I am unable to bring forward any anatomical observations on leptomeningitis or on hydrocephalus, where the disease was localized chiefly or entirely in the fourth ventricle, or its lining membrane; also, the fact should not be overlooked that this brain-cavity not only unites the canal of the spinal cord with the other ventricles, but also these other ventricles with the subarachnoid cavity, so that a very important function must be a priori assigned to it, both in health and in disease. Until the facts have been established anatomically, we have before us a puzzle which is very conveniently, but only apparently solved by the dogma of an otitis purulenta intima sive labyrinthica, proclaimed to be sure in infallible tones, but scientifically untenable.

Let us now return to the consideration of those disturbances of hearing which, from the absence of changes in the peripheral parts of the ear, or from reasons of probability, we regard as the results of anomalies in the nervous apparatus. Such anomalies may be frequently the reason why children, and especially those who are unusually slow in their development in all particulars, only begin to talk very late, and make such slow progress in their speech. Not uncommonly parents and physician think of the hearing only after a long time, and then the most superficial

tests immediately show it to be very much impaired. If the ear is carefully examined by an expert, the presence of changes in the tympanum, which may have been produced in early life, or which may be even congenital, cannot be denied with certainty; but there are cases where a congenital defect and arrest of development in the nervous or central apparatus may be diagnosticated with the greatest probability. Such are the cases where the formation of the skull is peculiar, the intellectual development and the power of walking are less than natural, and especially those where congenital anomalies and affections referable to the central nervous system, such as idiocy, epilepsy, deaf-mutism, exist in the family, particularly in the other children. In some of these families, old syphilis is an important element, as it is very apt to be in cases of total or very extreme deafness. It should by no means be understood, however, that, in the majority of these cases, anything is to be gained by specific medication. More commonly the indication rather is to try the treatment for chronic tympanic catarrh, as already given, if any reason is found for it in the condition of the ear, nose, and pharynx, or in the gradual diminution in the hearing. More can be gained not infrequently in this way than was at first expected. It may happen that, in addition to the congenital defect, catarrhal changes have occurred, which still further reduce the hearing power, and, if an improvement or even an arrest of progress can be brought about in this, something has been gained. Only a properly conducted treatment can, as a rule, show in how far the conditions in the tympanum are irremediable. The less the degree of hearing and the more invariable it is, the less prospect is there of a result from any such treatment.

Turning from the defectiveness of our positive knowledge in regard to diseases of the nervous apparatus of the ear to general observations upon the frequency of these diseases, it is firmly proven that a predisposition to brain

diseases exists in children, and as the labyrinth is in direct connection with the brain through its nerves and blood-vessels, we should expect secondary labyrinthine affections in them more commonly than in adults from the diseases of the brain. How little of this has been confirmed anatomically we have already seen. Of primary and independent lesions of the labyrinth, we know almost absolutely nothing with certainty, but from the independent position of the labyrinth in relation to the other parts of the ear, and from the probabilities, reasoning by analogy from the eye, they are relatively as rare in children as in adults. On the other hand, it is certain, as earlier observations have shown, that the tympanum is exposed in childhood to very many dangers, the results of which are, in a great measure, recognizable in dissection. It is also proven that the labyrinth and nervous apparatus are almost entirely inaccessible to direct therapeutic effects; while, in the middle ear, so long as disorganization has not taken place, much can be accomplished. In all doubtful cases, where any indications of the presence of catarrhal changes exist, it is better, both in a scientific and in a humane point of view, to institute the appropriate treatment for this condition.

In old nervous lesions, any treatment is wholly useless: in recent ones it is advisable to try bleeding, derivations, resorbents, and, later, electricity in one form or another, as sometimes the hearing power of itself improves up to a certain point, and an absolutely incurable process cannot be assumed at the very beginning.

V. DEAF-MUTISM.

THE same anatomical changes which at a later age simply cause total or great deafness, will, when they occur in the fœtus or young child, interfere with the developopment of speech; or, if the child has already learned to talk, cause it to lose its speech. In either case the child is a deaf-mute. According to the time at which the loss of hearing takes place we distinguish a congenital and an acquired deaf-mutism. Whether the deafness existed at the time of birth, or whether it has developed in the first or second year of life, cannot, in the majority of cases, be determined, as the assertions of parents in regard to the hearing of their children are based generally upon deficient and uncertain observations, and many are unwilling to believe or allow that their children were born with such a serious deformity. Even the thought of such a possibility on the part of the physician may be regarded as an insult. Since children who have lost their hearing at an age when they naturally could not speak are exactly similar, as far as speech is concerned, to those who were born deaf, it would be much better to consider both classes as congenital, and to apply the term acquired deaf-mutism to those who lose the hearing after they have learned to talk. In practice, the truth would be much better reached when inquiring the time of development of deaf-mutism, to ask the parents if the child has already spoken, and how much —the latter, how much the child has spoken, is important, as parents are apt to mistake the natural sounds pa-pa-pa

or ma-ma-ma for speech. If it should turn out that the child has really spoken, then should be noted at what age and from what disease the hearing was lost, and the length of time afterwards before articulate speech had dissappeared.

The number of deaf-mutes is very large, and varies greatly in different countries. It predominates, as a rule, in the male sex. According to George Mayr, director of the Royal Bavarian Statistical Bureau,[1] 152,751 deaf-mutes were found in 206,000,000 inhabitants:[2] in Europe, 7.81 to 10,000 inhabitants, and 3.82 in the United States of America. In the Netherlands, 3.35; Belgium, 4.39; Great Britain, 5.74; Denmark, 6.20; France, 6.26; Spain, 6.96; Italy, 7.34; Ireland, 8.25; Norway, 9.81; Sweden, 11.80 in 10,000 inhabitants. In the German Empire, there are 38,489 deaf-mutes of both sexes, or 9.66 in 10,000. Austria-Hungary has 20,699, or a ratio of 13.43 in 10,000, caused by the very great frequency of the disease in the Alpine lands, where the ratios vary from 16 to 44 in 10,000. In three districts of Carinthia and Salzburg, the ratio is more than 50; while in Switzerland it is 24.50 in 10,000. "Mountainous regions abound in deaf-mutes, but the plains and low countries seem to enjoy relative immunity."

Such statistics would be much more valuable for the physician if the congenital and acquired deaf-mutes, especially arranged as we have just suggested, were separated from each other. For an imperfect development of the hearing and of speech is well known to be one of the symptoms of an extended anomaly of the brain, frequently also of the skull and entire skeleton, not

[1] "Die Verbreitung der Blindheit, der Taubstummheit, des Blödsinns und des Irrsinns in Bayern nebst einer allgemeinen internationalen Statistik dieser vier Gebrechen." München, 1877.

[2] According to Helfft (Deutsche Klinik, 1857), the total number of deaf-mutes in Europe alone, exclusive of Turkey, was 145,000. Meissner (1856) called attention to the great inconsistency between the different statistics in regard to the number of deaf-mutes.

only in cretinismus and marked congenital idiocy, but also in the lesser degrees of these conditions, which we define as weakness or dulness of the senses. On the other hand, a similar intellectual weakness and social helplessness will befall a totally deaf child who is not subjected soon enough to proper training. On this account, an accurate separation between idiocy and deaf-mutism is, in certain directions, scarcely possible.

The pathologico-anatomical appearances in deaf-mutism —both congenital and acquired—do not differ in important particulars from those which have been found in other extremely or totally deaf persons. This is perfectly natural; the process has in itself nothing specific—merely the age at which the great deafness occurs produces the resulting complication, a loss of speech or muteness. We find nearly as many extensive tympanic diseases or malformations of the conducting mechanism described as we do abnormities of the deeper regions in the labyrinth, auditory nerve, brain, or at the common origin of the two nerves in the fourth ventricle.[1] Occasionally, however, no pathological condition is found on any of these parts by the common methods of examination, and we are obliged to assume a delicate anomaly in the structure of the brain. Among the diseases which most commonly produce total deafness, and therefore deaf-mutism, are acute otitis in scarlet-fever, especially when associated with diphtheria, epidemic cerebro-spinal meningitis, and

[1] Very thorough reports of the dissections of deaf-mutes will be found in Fr. L. Meissner's "Taubstummheit und Taubstummenbildung (Heidelberg u. Leipzig, 1856, pp. 55–64, 133–152). Meissner was for twenty-six years the physician to the Leipzig Deaf-mute Asylum, and his book is worthy the attention of every one who is interested in the subject. It contains fifty-six pages devoted to a list of publications on deaf-mutism and ear diseases. Moos, at the end of his work, "Klinik der Ohrenkrankheiten" (Wien, 1866), gives an interesting tabular view of the dissections of sixty-five deaf-mutes, partly taken from the older literature, and from Linke and Toynbee, partly from recent investigations.

the acute affection, not yet described anatomically, but probably proceeding from the floor of the fourth ventricle, as already shown and usually described as meningitis; next in order after these diseases come aural inflammations with measles and typhus.

Care should be taken not to consider deaf-mutism as an isolated symptom wanting in all variations of degree, as is too commonly done by physicians and deaf-mute teachers. We should remember that not infrequently in one family there exists with deaf-mutism deafness of various and usually extreme degrees. Above everything else, it should be remembered that all who are classified as deaf-mutes are not absolutely without hearing, as is often assumed by the public. The majority of them can hear loud noises, such as the ringing of a bell, clapping of the hands, or the sound of a trumpet, if within a certain distance of the head, although in some of these cases the vibrations of the air felt by the nerves of the skin and of the drum-membrane may assist the hearing. Many can also hear the tick of a loud repeater, not only when laid upon the ear or the bones of the head, but even at a certain distance away. By speaking into the ears of such persons with a speaking-tube, quite a number will be found who can distinguish the vowels perfectly well, and some who can repeat the consonants and words correctly. If, with such children, who are only extremely but not totally deaf, conversation through the ear-trumpet had been used early, and if they had been obliged to talk in the same way into their own ears, the learning of articulate speech would have been much easier for them, or in the case of a deafness acquired later in life, the distinctness of utterance would have been retained.

A child is obliged to catch the sounds which it hears chiefly through the imitative instinct, and thus gradually learns to speak. "The instinct of imitation is awakened in children at very different ages, and the power of

imitation is also variously developed. At first the words of the child have but a distant resemblance to those which it is imitating, and are generally only understood by those having the child in charge; but this improves with increasing rapidity. Very expert children sometimes develop a great dexterity before the end of the first year. Others only show any pleasure in articulate speech towards the end of the second year, or even later, and make very slow progress."[1] Thus it is with a child who hears well. If, however, the child is totally deaf, and perceives nothing of that which is spoken, the inducement to the "hearing reflex" and to imitation is wanting. Even if the child is not completely but only extremely deaf, a distinct impression of sound reaches the brain merely occasionally, so that the reflex activity to imitate what has been heard is but rarely excited, and furnishes no opportunity for a gradual progressive development. On the contrary, from the rarity of the external excitation which reaches the acoustic and speech centres, these become more and more dull and difficult to excite.

Furthermore, it can scarcely be denied that, as the result of the deficient specific irritation in the ears themselves and in the nerve centres, gradual changes in the form of retrogressive metamorphosis may occur which would naturally become more extended and assume a different character in the organism of a child just in the course of development than it would in an adult individual.

If a great degree of deafness exists in early childhood, it must exert a powerful influence in yet another direction. Assuming that we are dealing with a certain amount of deafness which in an adult would allow the comprehension of whatever was spoken loudly and distinctly into the ear or into the ear-trumpet, the fact that the person previously heard well and was accustomed to understand

[1] Kussmaul, "Die Störungen der Sprache" in v. Ziemssen's Handbuch, xii., Anhang. Leipzig, 1877, S. 48.

speech is of great assistance, as he can immediately say if a word is not spoken distinctly or slowly enough; he is also able to follow the lip-movements of the speaker, and striving from the sense and connection to complete what has been but half heard, he gets a tolerably complete understanding of the speech. This same degree of deafness affects the little child differently. To a child who has not yet learned to hear and pay attention to what is said, the words of its mother, assuming that they are perfectly well understood, make the same impression that a foreign language does upon us when we hear the sounds and words without knowing what they express. If, on the contrary, the child is very deaf, so that it hears what is said only under exceptionally good circumstances, it has no opportunity of itself to gradually learn the sense of what is spoken, and will soon cease to take interest in the sounds, and will confine itself to signs and signals. In this way, the hearing of words and understanding of sentences will be used less and less, and the child will give the impression that it is destitute of any hearing and is of weak intellect. As the inducement to imitate and reproduce speech is also wanting, the child who was originally only very hard of hearing becomes indifferent to the speech of its associates, and of itself will remain speechless or dumb. The same child, however, if treated like an adult, and spoken to distinctly and slowly into the ear, or, better, through an ear-trumpet, and at the same time if shown the object referred to, can be gradually brought to perceive and understand what is said, will take an interest in using the hearing, and will very soon begin to imitate what is said, and to speak. If these exercises in speech were further aided by obliging the child to talk often through the ear-trumpet into its own ear, in order that it may perceive its own voice, it would gradually gain control over this and over its pronunciation. Such a course of instruction, properly

and consecutively followed out, would result in the child remaining simply hard of hearing, but possessing a tolerably distinct articulation; in other words, deaf-mutism would be prevented.

It is still more easy to prevent and check the development of deaf-mutism in children who have already spoken for some time before the hearing was lost; and it is easiest of all in children who can already read. In adults, the non-perception of their voice exerts an unfavorable influence upon the modulation and pronunciation; in the child, a deficiency in the hearing of speech and of its own voice produces a rapid loss of the ability to speak distinctly, and finally a loss of speech itself if the use of what hearing-power remains is not strenuously insisted upon with the aid of an ear-trumpet, which instrument can also be used for the child's own voice: in this way a methodical instruction in articulate speech and in reading can be conducted. It is also very desirable to practise the child in reading words from the lips and in repeating what is said.

It is, of course, assumed in the above remarks that the intellect has not been permanently affected, as it is, for instance, sometimes from cerebro-spinal meningitis by secondary processes, from hydrocephalus, thickening of the ependyma, or hyperplasia of the meninges. In addition to the treatment by the teacher, medical treatment is necessary in some cases in which the pathological process is still active, and will sometimes produce a marked improvement in the hearing and be of great advantage to the pronunciation of the child and increase the possibilities of instruction. I can recall several children with aural suppuration, who had already been placed in deaf-mute asylums or were regarded as hopelessly deaf-mutes, in whom the deafness was so much reduced that individual instruction—and in one case even attendance at a public school—was sufficient to give them a very fair education

and pronunciation. Eventually there will be institutes in which the instruction of very deaf children will be undertaken in the proper method, and it will no longer be necessary to send them to deaf-mute schools when means do not allow of their being instructed alone.

The question at what age can loss of speech occur from a recently acquired deafness will be better appreciated after this discussion.[1] This will depend less upon the age of the patient than upon other conditions, viz., upon the degree of deafness, upon the intelligence and the amount of instruction the child has already received, and especially upon the proper appreciation by its guardians of its condition, and upon the degree of individual care expended on its education. Intelligent parents and teachers are often able, by great personal attention and by methodical instruction in speaking, to save very deaf children from true and total deaf-mutism, or to much improve those who have been regarded as deaf-mutes in their articulation and in their intelligence; this can be done the better, the greater the degree of remaining hearing which the child possesses. The boastful accounts in some of the French journals of "cures of confirmed deaf-mutism" could scarcely occur or find believers in Germany, since all of our deaf-

[1] Bonnafant (Bulletin de l'Academie de Méd., xxx., p. 860) feels certain that children up to the eleventh year always lose their speech soon after they have become deaf from any form of disease (some even within six months), and according to the degree of deafness, they lose it wholly or partially. He founds this belief on more than twenty original observations. Kussmaul (l. c., p. 259) says, "It appears that puberty is the extreme limit of time at which a person who can talk may, through acquired deafness, lose his speech. In most of the cases of those who have already learned to talk, the loss of speech from a deafness occurs in the fourth year, occasionally even up to the tenth year, and only in extremely rare cases up to the fourteenth year. Up to the age of puberty, the methods of formation of words are not so firmly fixed as they are later in life, when the deafness may interfere with but cannot wholly destroy the ability for their formation." The author, in his Lehrbuch (sixth edition, p. 569), wrote, "Children who can already speak may lose this ability if they become deaf at any time up to the seventeenth year. Even in the eighth to the ninth years the loss of the hearing may make the speech very imperfect."

mute asylums follow substantially the same methods of instruction, and therefore many intelligent children of the better classes might figure in Paris as cured deaf-mutes.

In the two oldest deaf-mute asylums, that founded by Abbé de l'Epée in Paris, 1760, and that by Samuel Heinicke in Leipzig, 1778, two different methods of instruction were followed, each of which is still extensively used.

The French system confined itself to teaching the gesture, finger, and written language, while Heinicke, stimulated by the writings of the Swiss physician Amman,[1] endeavored to rescue the unfortunate children from their mute condition and to give them a certain enunciation. According to the German method, which is used exclusively in Austria, Holland, and Switzerland, and is rapidly extending in England, Italy, North America, and Scandinavia, the deaf-mute is taught to read words from the mouth of the speaker, studying the word-picture, so to say, and then by imitation forming it himself. The imitation of the movements is assured by touching the larynx and the chest in order that the vibrations accompanying the speech may be perceived through the sense of touch. According to his intellectual and mechanical ability, according to the degree of existing hearing, and the age at which methodical exercises in the apparatus of the voice have been begun, will the deaf-mute acquire a greater or less capacity for speaking.[2] The speech always lacks the euphony which is only attained and regulated when the person can hear his own voice; it is somewhat hoarse and monotonous, and characterized by the peculiarity that the single syllables are not run together but sharply separated;

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[1] Surdus loquens seu methodus, qua, qui surdus est, loqui discere possit. Amstelodami, 1692, 12. In deutschen Uebersetzungen. Prenzlau und Leipzig, 1747, 8, und von Grashoff, Berlin, 1828, 8.

[2] The arrangement of instruction in the five classes is accurately given by Meissner, l. c., pp. 326–333.

the voice is, as a rule, too loud, reminding one who is unaccustomed to it of the barking of an animal. The advantage of the German method of instruction is very marked in two ways; it enables the well educated deaf-mute to converse with those who hear, without the latter being obliged to learn the gesture and finger language, often a great gain in earning a living; and, again, the regular use of the voice counteracts the tendency to the development of respiratory diseases, to which deaf-mutes are particularly liable on account of the weak development of the chest and its muscles from the slight use made of the lungs. It is well established that an unusually large number of these unfortunates die of tuberculosis between their fifteenth and thirtieth years.[1] A statistical comparison between the death rate of deaf-mutes instructed under the German and French methods would be possibly very instructive in this regard.

Finally, it should be stated that an immediately direct hereditary tendency to deaf-mutism is less common than a family tendency. Even when both parents are deaf-mutes, the marriage shows an hereditary transmission of the disease only in exceptional cases; on the contrary, congenital deaf-mutism is often seen in several children of one family. It is asserted that deaf-mute fathers more often transmit the affliction than deaf-mute mothers. The truth of the assertion which has been held for a long time, that the offspring of relations, and especially of families in which intermarriages have for generations been common, showed a relatively large proportion of deaf-mutes is very much shaken by recent statistics, more particularly since the modern theories in regard to the injurious influence of intermarriages. On the other hand, however, it is certain that deaf-mutism is unusually frequent among the Jews.

[1] Meissner (l. c., p. 130) gives a table of 61 deaths of pupils who were or had been in the Leipzig asylum. In 59, the cause of death was fully established, and 30 of these died of consumption of the lungs, 4 of inflammation of the chest, 1 each of pharyngeal phthisis, phthisis, and hydrothorax.